TEXTILES PAPER LEATHER

AMERICAN DYESTUFF REPORTER

Including the Proceedings of the
AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

VOLUME XIII SEPTEMBER 8, 1924 NUMBER 15

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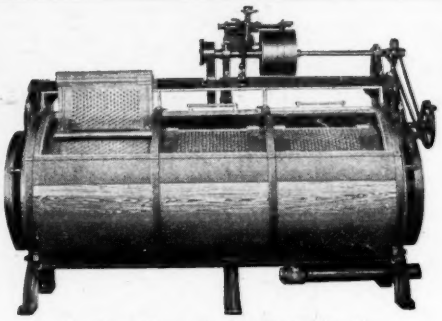

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VOLUME XIII NEW YORK, SEPTEMBER 8, 1924 NUMBER 15

Seeing Colors Through a Nicol Prism

A Novel but Simple Method of Examining and Matching Colors on Textiles by Removing the Possibilities of Error Due to the Reflection of Light from the Surface of the Material—The Article Explains How This Surface Sheen, Which Prevents the Dyer from Seeing the True Color of the Cloth, May Be Avoided by the Use of the Nicol Prism

By WALTER C. DURFEE

IN museums and stores the articles on exhibition are frequently protected by glass coverings, or showcases. Looking into these showcases it frequently happens that the spectators, instead of seeing the exhibits inside of the cases, see only the image of some electric light reflected in the glass or the picture of some brightly lighted portion of the room reflected in the same manner in the glass case. Even when the lights are placed inside of the case and when the spectator moves to the most favorable position there is without doubt some faint image reflected from the glass so that the articles within the case cannot have exactly the same appearance that they would have outside of the case. This is true even if the glass be entirely colorless, because the reflected images come from the surface.

Anyone who desires to match colors, therefore, would hesitate to place his samples inside of a glass case for this purpose. Nevertheless, every object has a surface of its own which reflects light. The surface of the fiber of wool, cotton or silk reflects light in about the same manner as the glass case covering reflects it.

The color which one wishes to see in the fiber is, therefore, at all times covered by a surface capable of reflecting ordinary light. The color is partly concealed, just as the objects in a museum are to a certain extent concealed by the glass cases.

To realize the truth of this statement it is only necessary to examine darkly colored samples. Even on textiles, which have a rough surface and do not reflect images like a mirror, one can see a bright glistening, like the glisten of light reflected from rippled glass. On fibers this can be seen with the naked eye and still better with the microscope. The same reflection is present on fibers of all color, whether dark or light.

The apparent color of any sample is consequently a mixture of two colors—first, the color of the surface, which is usually the same as the color of the surrounding objects and lights; and, secondly, the color of the inside of the substance. Everything which the color-matcher sees is paler than the true color which lies beneath the surface.

Method of Avoiding Surface Sheen

Probably most color-matchers can satisfactorily estimate the true color and discount or ignore the sheen from the surface. Yet for the very purpose of training the eye in an accurate judgment of colors it is useful to see the true colors in the absence of the surface reflections.

When this facility is established in the way that we are about to relate, most of the deeply colored textile fabrics display a beautiful purity and intensity of coloring, and, by a strange coincidence, the little specks of dust lying on the fabrics also become visible so soon as they cease to be concealed by the brightness of the surface.

The method of getting rid of the sheen of the surface is simply to look at the surface through a Nicol prism while the sample is held in a suitable position. (It is not possible to wholly destroy the surface brightness by roughing the surface, as this simply scatters the sheen, just as the image of the sun on still water is scattered by the waves.)

The Nicol Prism

The Nicol prism is mentioned in the Century Dictionary and Cyclopedia, under the heading of "Polarization of Light," as follows: "Polarization of light: A change produced in light by reflection from or transmission

through, certain media by which the transverse vibrations of the ether are limited to a single plane, while in a ray of ordinary light these vibrations take place indifferently in any plane about the line of propagation. Polarization may be effected: (1) By reflection from a surface of glass, water or similar substance, and it is most complete if the angle of incidence* has a certain value, depending upon the substance, called the angle of polarization (for glass, 54½ degrees), the tangent of this angle being equal to the refractive index of the given substance (Brewster's law); (2) by transmission through a series of transparent plates of glass placed in parallel position at the proper angle to the incident ray; and (3) by double refraction in any transparent anisotropic crystal. In the last case the two rays into which the incident ray is separated upon refraction are polarized in planes at right angles to each other, as, for example, in transparent calcite (Iceland spar), in which this double refraction is most marked. A prism of Iceland spar may be prepared in such a way that one of the two refracted rays suffers total reflection and is extinguished; the other ray, which passes through, is polarized, its vibrations taking place in the direction of the shorter diagonal of the cross-section. Such a prism is called a Nicol prism, or simply a Nicol."

From this it is evident that light reflected upon the surface at certain angles can be considerably extinguished. Looking at a sample of ordinary textiles at such an angle through the Nicol prism, practically all the surface sheen can be extinguished. Only a fraction of the ordinary light from the interior of the material is extinguished. The remaining colored light comes through the prism. The observer sees the practically true interior color of the sample in this slightly subdued light.

To obtain this interesting and beautiful result, one places the sample in a certain position. The sample must be placed so that if a string were stretched from the window to the sample and then from the sample to the eye, the difference between the first and second directions would be about 70 degrees, more or less according to the kind of material being matched. Of course, the directions from the sample to the various parts of the window are not all identical, but by taking the average direction of the window or the direction of its brightest part one can ordinarily secure very beautiful results, especially when the window is not too near or too large. The prism should be rotated until results indicate that it is right side up.

Probably the Nicol prism or some modification of it is the most convenient known way of avoiding the surface glare from materials which are being examined. There are other ways, however, such as that of taking the glare out of the light in the first place, by polarizing it or by finding how to use the naturally polarized light as found in certain parts of the blue sky.

*This angle is measured not from the surface but from a line perpendicular to it.

There are, of course, some difficulties and exceptions in these matters, particularly in the case of metallic surfaces which differ from other materials. There are also some faint images which the polarized light momentarily excites in the human eye and some remote chances of having reflections from the Nicol prism itself; but still, under all ordinary circumstances encountered in color matching, it is convenient to have on hand a Nicol prism for the occasional purpose of clearly seeing through the surface glare of materials.

FAST DYE AND UNSHRINKABLE LINENS

The Boston Better Business Commission is evidently intent upon discouraging and abolishing certain false claims and statements made by textile manufacturers in their advertising. The Commission has issued the following bulletin which describes tests made on samples of linen. The results of these tests reveal the extent of the practice of falsely labeling goods as "fast" and "unshrinkable." Both of these terms, widely applied to textiles of every description, tend to mislead the purchaser. As is generally known among dyestuff manufacturers, the term "fast" is utterly meaningless unless it is used conditionally to specify some definite kind of fastness. It is greatly to the credit of the Commission that it is not only alert to this practice, but is so interested as to carry out the tests described and to publish the results in the form of a caution to textile manufacturers to be reasonably honest in their descriptions of the fabrics they sell.

The bulletin follows:

Certain advertised claims made for colored linens deserve attention. Two are important: the one type, those specifying fast colors; and the other, statements emphasizing the unshrinkable properties of the goods. To establish the validity of these representations, the Boston Better Business Commission made some simple tests.

Fastness. The phrase "fast-dye" applied to any fabric is meaningless. Loosely used, it is misleading by reason of the fact that there are several kinds of fastness; for example, "fast to boiling," "fast to sunlight," "fast to perspiration," and "fast to laundering."

Further, each of these designations is vague because the simple phrase "fast to laundering"—as an instance—gives no inkling of the conditions under which the color will stand up.

No standard test has been set. The manufacturer either makes his own or calls the product fast without testing.

So also may be challenged "fast to perspiration," "fast to sunlight" and "fast to boiling."

For its own information, the Boston Better Business Commission therefore sent eleven samples of blue linen to a reliable commercial laundry with instructions that they be washed six times according to the regular procedure for colored linens. All these linens were bought as "fast-dye." Each washing lasted 76 minutes. At no time did the water exceed 120 degrees in temperature. The pieces were dried and ironed after each washing.

None was perfect. Two were good. The rest were poor.

As a check, the samples were subjected to a further test of boiling for fifteen minutes with a mild soap. Nine samples faded badly—worse than when laundered—while the other two held their color but darkened somewhat.

Whether or not the tests were reasonable, this conclusion seems clear: that the majority of these samples deserved no advertised designation wherein the word "fast" appeared. The comparatively good record of two of the samples strengthens this contention.

Shrinkage. Some of these goods were sold as "unshrinkable." Others were represented only as "preshrunk." No statement was made as to the remainder.

In this connection, it may be stated that the word "unshrinkable" is not relative but absolute in meaning.

All the samples shrunk: none could be correctly advertised as "unshrinkable."

Because it appears that the terms "fast-dye" and "unshrinkable" as applied to colored linens have been abused, the Boston Better Business Commission suggests that unless you are certain of the facts, great care be exercised in the use of these designations.

The Carbonization of Wool Materials

The Methods Employed—General Details of the Carbonizing Process—Spotting and Tendering of Wool by Carbonization—Carbonization a Definite Cause of Spotting—Disadvantage of Oil in Piece Goods—Spotting and Tendering of Wool—Causes of Injury—Action of Dilute Sulphuric Acid

By ISMAR GINSBERG, B.Sc., Chem. Eng.

THE process which is known as carbonization is one of the most important steps in the treatment of raw wool and in the finishing of woolen goods. The purposes of the process are too well known to require explanation here. The fact that various natural though undesirable substances, such as burs, pieces of wood, straw and other vegetable matters, are found mixed with raw wool frequently necessitates the removal of these impurities before the wool can be woven into cloth. This is particularly true if the wool is to be stock-dyed. While this treatment of raw wool is an important application of the carbonization process, it is of no greater importance than the use to which this process is put in the removal of particles of cotton, burs, straw and other vegetable specks from *woven* woolen cloth which is to be piece-dyed. The application of the carbonization process in the production of reclaimed wool from waste and rags is also of considerable importance.

The Methods Employed

All of the methods employed in the carbonization of wool depend on the principle that the active agent will carbonize, destroy, solubilize or so change the vegetable matter that is mixed with the animal wool fiber that the matter can be readily removed without injuring the fiber. Unfortunately, the theory of the process does not work out as one would want it to in actual practice. The chemicals employed in the carbonizing process attack the wool as well as the vegetable fiber, and the unfortunate part about the whole process is that the injury to the wool is not detected until the fiber has been woven into fabric and dyed or finished. Then defects appear which can be traced back to the carbonizing process. It is therefore of great importance that strict control should be exercised over this process and that all the conditions and factors which influence the results obtained—such factors as the temperature, the time of action of the chemicals on the fiber, the concentration of the reagents employed and the immediate after-treatment that the cloth is subjected to—should be watched with the greatest of care.

Whether an acid is used directly or not, the carbonization of wool is effected by the action of acids that are developed by the contact of the chemical with the wool fiber. Thus, sulphuric acid of various strengths may be employed in the carbonizing process, or else such chemicals as aluminum chloride, magnesium chloride or magnesium bisulphate may be employed. In the case of the chlorides a reaction takes place between the moisture in the woolen fiber and the chemical to produce hydrochloric acid, which then attacks the vegetable matter that is mixed with the woolen fiber.

General Details of the Carbonizing Process

It has been said that the carbonizing process must be watched with great care, for the chemicals employed therein have an action on the woolen fiber as well as on the vegetable matter mixed with it. Defects in the woolen fabric or fiber may be brought about by a variety of causes. In the first place, the unequal distribution of the carbonizing chemical throughout the material is one of the most deleterious conditions of the process. It is most important to see that every part of the fabric and fiber is thoroughly impregnated with the chemical, whether sulphuric acid or aluminum chloride is employed. The soaking process should be allowed to continue for a

sufficient length of time to insure proper impregnation and the goods should be carefully folded, as careless or uneven folding will also produce uneven penetration of the carbonizing solutions. It is also important that the drying operation which follows the soaking process be carefully carried out so that both uniform and sufficient drying takes place. Another cause of defects in the carbonizing process is the exposure of the wet cloth to light. It appears that the light has some effect on the reaction that takes place between the carbonizing agents and the cotton, as well as that which can also take place between the woolen fiber and the chemicals. Hence, it is decidedly inadvisable to allow the wet cloth to remain exposed to light.

Then, again, if the cloth is permitted to remain standing for too long a time between its passage through the acid liquor or the solution of aluminum chloride and its hydro-extracting, defects in the carbonized goods are also possible. Furthermore, when the cloth is soaped before the carbonizing treatment it is important to see that all of the soap is removed. It has been found that condensed water in the carbonizing chamber, as well as soap, acid or alkalies, is liable to cause spotting in the woolen goods when they are subsequently dyed.

Spotting and Tendering of Wool by Carbonization

There has been considerable experimentation and investigation carried out on this subject, both in this country and abroad. The governmental testing laboratories in Berlin recently made a very exhaustive investigation of this subject. The spotting of woolen goods in the dyeing process is quite a frequent occurrence and there are really many causes which can produce spotting of woolen goods besides carbonization defects. It is well to bear these causes in mind when searching for a possible reason for spotted dyed woolen goods.

Spotted fabrics may be due to the improper and irregular wetting down of the goods before they are introduced into the dye bath. It may also be caused by too high a temperature in the dye bath at the moment when the fabrics are introduced. If the woolen material is not held in the proper taut position during the dyeing process, spots can be produced, and likewise these spots may be caused by the dyestuff itself not going on the fiber in a uniform manner. Spotting may result when the dyestuff is not properly filtered before being used, when the dye bath is filled too full with the goods or when the fabrics are not subjected to sufficient cooling after the soaping treatment. This refers particularly to goods dyed in black and blue shades.

It is evident that there are many different causes to which spotting of woolen goods during dyeing can be assigned. It is true that improperly carbonized materials will not be uniformly dyed, but it would not do to look to the carbonizing process each and every time that a spotted fabric was obtained, unless it was absolutely certain that all of the other causes were first eliminated. It is necessary that considerable thought be given the problem in order to search for the cause of the spotting of the goods in the dyeing operation; the wool dyer must have all these various details literally at the tips of his fingers in order to be able to trace the spotting to the correct cause.

Carbonization a Definite Cause of Spotting

However, the fact remains that unless the carbonizing process is carried out with great care—and this applies not only to the details of the process itself, the temperature, concentration of solutions, etc., but also to the preliminary treatment of the wool and the proper choice of materials so that impurities are not present in the fiber—spotting is very liable to result.

In the case of raw wool particular reference is made to the natural fats and oils which it contains. The immediate effect of the acid on the wool grease or oil is to neutralize the alkaline suint, which would at once result in setting free the fatty matter. This causes many serious difficulties in the carbonizing process and is productive of spotted fabrics when the cloth made from this woolen fiber is dyed. It is also doubtful whether the acid can reach and attack all the vegetable matter in the woolen fiber, as the liberated fatty matter will be bound to have a tendency to cover part of the fiber and prevent the acid from coming in contact with it.

Disadvantage of Oil in Piece Goods

Furthermore, in the carbonization of piece goods which contain oily and fatty matters of different origin serious difficulties are encountered in obtaining perfect carbonization and subsequent dyeing. The heat in the heating chamber through which the acid-impregnated wool is passed will volatilize the oily impurities. Acid will be evaporated along with the oil and the vapors will condense on the metallic parts of the heating chamber and eventually drop back again onto the fabric that is being dried. The acid will, of course, tend to dissolve the metal with which it comes in contact, and hence there will be precipitated on the fabric metallic salts which afterwards seriously interfere with the dyeing process. This is one way in which spotting can be produced by incorrectly operating the carbonizing process. The serious feature is that the presence of these deleterious matters in the woolen piece goods will not be detected until the cloth is dyed.

It has been found in practical work that large brown spots are often formed on woolen fabrics which are dyed black after carbonization owing to the improper operation of the process. This is rather a common occurrence, but it is not the most injurious effect

that the carbonizing process can have on the woolen fiber. It has been similarly found that not only are spots formed but that at the points where the spotting occurs the woolen fibers have become tender and have actually rotted away. Spots in the woolen goods have an entirely different feel than the rest of the fabric and the spotted places do not have the same affinity for the dyestuffs employed in coloring woolen goods as the remainder of the fabric. Such spotted places on the fabric cannot always be detected either by microscopic or by mechanical methods.

Spotting and Tendering of Wool

The investigation made at the governmental testing laboratories in Berlin states definitely that the places where the woolen material was spotted, when examined under the microscope, showed the woolen fibers to be completely destroyed. This appears to be contrary to the view generally held that the action of the carbonizing fluids does not affect the woolen fiber at all, and some investigators have even held that the effect is rather to strengthen than to injure the fiber.

Further details indicate that the pressure of the thumb was sufficient to tear through the fabrics at the spotted places, while at other parts of the same piece of goods the fibers were strong and could not be torn except with considerable difficulty. In mathematical terms it may be said that the strength of the spotted parts was only half that of the unspotted portions.

Microscopic examination of the spotted fabrics corroborated the results obtained in the mechanical testing. There was a considerable difference between the wool fibers which were spotted and those which were not. There was no doubt but that the fibers had been seriously injured by the treatment that they received in the carbonization. The woolen fibers from the spotted parts of the fabric appeared under the microscope as opaque threads, with frayed edges. The uninjured fibers had the usual scaly appearance of wool under the microscope. The carbonization had removed the scales entirely.

The Causes of the Injury

The causes of this injury to the woolen fiber can be laid to the incorrect manipulation of both the fluids and the piece goods in contact with them during the carbonizing process. The concentration of the acid solution was either too strong or the duration of the acid treatment was too prolonged. Then, again, they may be brought about by too high a temperature in the hot drying chamber. On the other hand, the concentration of the acid in contact with the cloth at isolated points may have been greater than at the rest of the fabric, with the result that the acid ate too deeply into the fibers and so produced spots.

Another important cause of improper carbonization is faulty mechanical manipulation of the goods as they enter and leave the carbonizing bath, as well as during the time that they remain in the bath. It is very essential that all parts of the fabric be uniformly impregnated with the acid solution and the time of contact between the acid and the cloth should be the same in every part of the fabric. Otherwise spotting will ensue.

When sulphuric acid is employed as the carbonizing agent, it is, of course, essential to see that the cloth does not come in contact with metals that are attacked by the acid. This is a sure way of obtaining a carbonized product which will dye unevenly. Whatever metal is used in the process must be covered with an acid-proof varnish or lacquer, so that no corrosion of the metal can take place and no salts can be precipitated onto the cloth. This applies to the hydroextractors as well as to other pieces of apparatus employed in the carbonizing operation. The drying chamber should be thoroughly cleaned from time to time to avoid the formation of deposits on the walls and sides which may drop down on the cloth as it is being dried. The temperature within the chamber may be easily regulated by means of a suitable type of thermostat.

The Action of Dilute Sulphuric Acid

One of the latest developments in the field of carbonizing, which, it is reported, will soon take practical shape, if it has not done so already, is the carbonizing of wool by the use of very dilute sulphuric acid. The use of acid of as low a concentration as possible has two important advantages. In the first place, the more dilute the acid the less the chance of any injury being done to the woolen fiber. In the second place, the lower the concentration of the acid the less alkali need be used in the neutralizing process to remove the same. The second of these advantages is not of any moment, but the first is of great importance.

There is doubt that the carbonizing process is fraught with many serious disadvantages. Nevertheless, the process must be carried out in spite of the bad results that are sometimes obtained with it. If a process can be developed that will circumvent these difficulties a real forward step will be made. It is our understanding that such is claimed for the new process in which an extremely dilute sulphuric acid is employed.

The details of this process are still unknown. The literature contains considerable reference to the employment of acids as carbonizing fluids. Usually a sulphuric acid having an approximate density of 1.03, which corresponds to about 5 per cent of H_2SO_4, is applied at the ordinary room temperature. Then the cloth is dried at a temperature of 85 to 100 deg. Cent. and this is followed by a baking at a considerably

higher temperature. It has been claimed that superior results can be obtained by using an acid of approximately 1.5 per cent concentration at a temperature of 40 deg. Cent., and then drying the acid-impregnated fabric at a temperature of 100 deg. Cent. The general opinion is that when wool is carbonized with a weaker acid and perhaps at a slightly higher temperature, the dyeing will be more even and the woolen cloth will have a better feel. The increase in temperature makes up for the decrease in the concentration of the sulphuric acid solution, so that the duration of the treatment is approximately the same in both cases.

In conclusion, it must be emphasized again that the carbonizing process is a very important part of wool treating. The process is extremely useful and it is rather unfortunate that such difficulties should surround it as have been described. Of course, careful attention to details will yield good results, but sometimes bad effects are obtained under the best possible conditions. The use of sulphuric acid or of aluminum chloride in the process will give good results, although it is sometimes claimed that the latter chemical is not encompassed with some of the troubles that are encountered in the former. However that may be, the fact remains that carbonization is by no means a simple matter, that there is room for improvement, and that textile men are becoming interested in the matter and are now developing new methods possessing material advantages over the older ones.

Microbiological Injury to Fibers and Fabrics

By CHARLES E. MULLIN, F.A.I.C.

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THE term mildew covers a wide range of damage caused by algae, fungi and bacteria, to which all fibers are more or less liable, but particularly cotton and cellulose. The spores and cells of many micro-organisms are normally present upon raw cotton; and while most of them are killed in the various manufacturing processes, some may escape, as many of these spores and capsules have such a high thermal resistance that they will survive freezing or boiling in water. Also, reinfection of sterile material may be caused by spores or cells carried by the air which are universally present.

Cellulose free from lignin forms a fairly good food material for a wide variety of micro-organisms. There are at least several thousand varieties of molds and innumerable bacteria, but on fabrics molds of the Aspergillus type, such as Asp. niger (black) and Asp. glaucus (green), are the most common type of mildew. White, yellow and brown Aspergillus types are also common, and may include Asp. orzyae. The Penicillium and Mucor types of mold require slightly more moisture than some of the Aspergillus. The P. glaucum (green) is one of the most widely distributed molds; M. mucedo and Streptothrix are common, but the Rhizopus and Cladosporium are rarer on fabrics.

Brown mildew is often caused by Puccinia graminis and may be mistaken for iron stains, from which it is differentiated by the Prussian Blue test. Yellow mildew is sometimes Oidium aurantiacum. A less common black mildew is caused by a genus Tilletia, and the pink is possibly due to Torula. There are also purple and other colors of mildew. The two bacilli most commonly found on fibers are Bacillus subtilis and B. prodigiosus, but B. mycoides is also found, as well as Sarcina lutea and S. aurantiaca, etc.

The changes produced by these organisms are both chemical and physical or morphological. Many of the algae and fungi produce a mycelium which is entirely upon the surface of the fiber; others, as, for instance, the Streptothrix, penetrate the fiber, while the bacilli produce colonies which gradually penetrate the fiber. These micro-organisms produce enzyme products, one of which is cytase, also called cellase and cellulase, which converts the cellulose, through various stages, into glucose, which is partially utilized by the organism. Other organisms, with their enzymes, convert cellulose, proteins, fats and carbohydrates into such final products as carbon dioxide, hydrogen, water, nitrogen, ammonia, nitrites, nitrates and organic acids. In converting the cellulose into glucose, the cellulose is first hydrated, and in this condition it is more readily stained by dyes and retains them unusually well. As the damage progresses the fiber loses its tensile strength, becomes brittle, etc., until it has no further value as a textile material.

This microbiological action on the cotton fiber is readily followed microscopically in the later stages, but in the primary stage it is best followed by the swelling action of a solution containing equal parts of carbon bisulphide and 9 per cent caustic soda, which causes the normal cotton fiber to have a microscopic appearance similar to that given by Schweitzer reagent—i. e., swollen with constrictions; while the damaged fiber swells more rapidly than the normal fiber and is almost uniformly swollen, without constrictions, possibly due to the destruction of the cuticle

by the micro-organism. Also, the copper value of the fiber increases as the damage proceeds.

Certain types of cotton resist microbiological attacks more than others, and some treatments, such as bleaching and dyeing, increase this resistance. Warmth, darkness, moisture, stagnant air and the presence of starch and gums, such as are commonly used in sizing materials, favor microbiological growth, and the addition of microbicides to the sizing is not always permanently satisfactory, but a low moisture content is particularly detrimental to all microbiological growths. Acetylated cellulose is particularly resistant to micro-organisms.

Good results are often obtained by adding antiseptics to the finishing or sizing materials, such as salicylic or benzoic acid, sodium benzoate, copper, lead, zinc or mercury salts, boric acid, cresol, phenol, resorcinol, pyridine or formaldehyde. However, this alone is not always successful, as these microbicides are usually present only in very small amounts and the most efficient compounds often cannot be used upon the material to be finished on account of its poisonous character, lack of permanency, odor, etc.

The best method of preventing microbiological damage is by keeping the moisture content of the fabric low and by storing in a light, cool, airy place. Avoid the use of excessive amounts of starch and sizing gums, as they particularly facilitate microbiological development.

An interesting cause of uneven dyeing may be found in some instances to be due to the action of the enzyme ptyalin of saliva, which has the property of causing cotton to absorb dyes more readily than is normally the case, as was mentioned above in regards to mildew. In this way saliva spots or such slight mildew as would be invisible to the eye may be sufficient to cause spots on the dyed goods. Diastase also exhibits this accelerating action on cotton to be dyed.

New Developments in the Use of Naphthol AS

The Chemistry of the Naphthol AS Process—Results Obtained in Ultra-Filtration—Importance of the Degree of Colloidal Dispersion—Behavior at Different Temperatures—Absorptivity of the Naphthols—The Aging of the Solution of Naphthols—Use of Formaldehyde—Life of Naphthol Solutions—Use of Protective Colloids—Use of Gelatine Solutions—The Naphthols Themselves

By DR. S. RATH

Translated by Ismar Ginsberg, B.Sc., Chem. Eng.

[NOTE.—*The following article, which tells some of the new developments that have taken place in the use of Naphthol AS, is abstracted from an address by Dr. Rath before the Congress of the International Society of Color Chemists, which was held in Salzberg last year. The paper contains interesting information on this subject and is well worth the attention of American color chemists and technologists.—Trans.*]

THE Naphthol AS process has in recent years acquired considerable importance. The process possesses certain advantages over its predecessors which have made its introduction and development in the textile field an easier matter than is generally the case with new processes. The properties which stand out before all others are the possibility of developing the dyestuff on the fiber by a wet process, and hence the practicability of using the process in machine dyeing. Further advantages are the greater fastness of the color produced on the fiber, the considerable number of shades and tints available, the fact that copper has no action on the developer, etc. Nevertheless, one of the serious disadvantages under which the process was first used was its limitation to the conditions under which para nitraniline red is produced on the textile fiber, with the result that the real possibilities of the new process were not appreciated or given a chance for full development.

However, conditions changed when in addition to the first two members of the Naphthol AS series, namely, Naphthol AS and Naphthol AS-BS, there were added three other members, Naphthol AS-BO, Naphthol AS-RL and Naphthol AS-SW.

THE CHEMISTRY OF THE NAPHTHOL AS PROCESS

In investigating the chemistry of the process it soon became clear that not only is the Naphthol AS group fundamentally much different than beta naphthol, but that the individual members of this group differ among themselves. It was shown that the group differs markedly from beta naphthol in the degree of substantivity. The important consideration is the action of the Naphthol AS compound on the colloidal solution of the dyestuff and the absorption of the same by the fiber, which is apparently a chemical process. By this process the substantive dyestuff is fixed so firmly to the textile fiber

that it can no longer be washed out of it. It is held by some that Naphthol AS does not enter into a chemical reaction with the fiber as does a substantive dyestuff. In the case of the Naphthol AS, the adsorption is a completely reversible process. Thus, it is possible entirely to remove the naphthol from the fiber by merely washing the fiber with water, the efficacy of the washing process being dependent on the character of the naphthol employed.

The Essential Point in the Author's Study of the Matter

The essential point of the author's investigations and study on this matter is as follows: A close examination of the different naphthols of the AS series leads to the conclusion that in their alkaline solutions these substances are in the colloidal condition. To be sure, because of the fact that the substituted naphthols behave so differently from beta naphthol, the colloidal character of the solutions of the former must be much more strongly emphasized than in the case of beta naphthol.

Certain experiments which were made under the direction of the author have corroborated his deductions. The solutions of Naphthol AS and its homologues are typical colloids. Under the ultra-microscope they show the Brownian movement and are seen to be composed of sub-microns. Furthermore, the solutions show the characteristic Tyndall cone when a strong beam of light strikes them.

Results Obtained in Ultra-Filtration

Very interesting results are obtained in ultra-filtration. Ultra-filters in which the width of the pores is less than 1.5 mu hold back all the naphthol. The solution that passes through the filter will not combine with diazo compounds. On the other hand, beta naphthol has been shown to exist only partly in the colloidal condition, but the part that is colloidal is very highly dispersed. The greater part of the solution is in the form of a true solution; or, if this is not true, then the colloidal state of the naphthol in solution is so fine that it cannot be determined by any of the agencies commonly employed to distinguish and ascertain the colloidal state of solutions. On the other hand, there is no question but that the naphthols of the AS groups form colloidal solutions with a varying degree of dispersion.

The Importance of the Degree of Colloidal Dispersion

The degree of colloidal dispersion of the naphthols of the AS series is very important from a practical standpoint as well as from the theoretical standpoint. There is a relation between the size of the molecules, the solubility, the degree of dispersion and the substantivity of the individual naphthols. The author cannot now go into this question in real detail for two reasons: First, because the work is still in its infancy, and second, because time and space do not permit. However, the following remarks may be made regarding this matter:

The larger the molecule of the naphthol of the AS group, the more difficult it is for it to go into solution in the caustic soda lye. This presupposes, of course, that the naphthol does not contain any special group, like the sulphonic acid radicle which tends to render it more soluble. Under these conditions the degree of dispersion of the naphthol will be less, and the stronger will be its affinity for the cotton fiber. From this standpoint, the various naphthols used at the present time may be arranged in the following series: Naphthol AS, Naphthol AS-RL, Naphthol AS-BO, Naphthol AS-SW. In other words, the Naphthol AS is the least soluble, exhibits the greatest degree of dispersion in solution, and possesses the least substantivity, while Naphthol AS-SW possesses the greatest substantivity, exhibits the least degree of dispersion in solution, and is the least difficult to dissolve.

The following experiment is very enlightening from this standpoint: If a mixture of alkaline solutions of Naphthol AS and Naphthol AS-SW in a concentration of one-thousandth of a molecule per liter is brought on an ultra-filter with pores of approximately two mu width, the Naphthol AS solution passes through the filter almost completely, while the solution of Naphthol AS-SW remains behind on the filter. As Naphthol AS gives a very brilliant red with the dyestuff Fast Red GL and Naphthol AS-SW a Bordeaux shade, it is a comparatively easy matter to differentiate between the two naphthols.

Behavior at Different Temperatures

The alkaline solutions of the various naphthols exhibit typical phenomena which are characteristic of colloidal solutions as far as variation of temperature is concerned. In other words, as the temperature varies they behave like characteristic colloidal solutions. Thus, the higher the temperature, the greater the dispersion of the colloid in the dispersive medium and the less the degree of substantivity of the solution. Hence, in the process of bottom dyeing, when the operation is carried out at a high temperature, weaker tones of color are always obtained, than when the dyeing is conducted at a lower temperature. Particularly striking is the difference obtained in the dyed cloth when Naphthol AS-SW is employed at different temperatures.

The action of electrolytes, such as common salt, Glauber salt and the like, is also marked by a reduction in the degree to which the naphthol is dispersed in the solution. The net result is that the naphthol is better absorbed by the textile fiber. However, the use of electrolytes in the case of the difficultly soluble Naphthol AS-BO and Naphthol AS-SW is dangerous, as the naphthol may be caused to separate into flakes.

Absorptivity of the Naphthols

Each individual naphthol possesses a certain degree of absorptivity; that is, ease with which it can be absorbed by the textile fiber. This is influenced by various conditions, such as variation in the temperature and addition of electrolytes. When the bottoming process is carried out at too low a temperature or when the degree of dispersion of the naphthol colloid is reduced to too small a magnitude by the addition of too much of the electrolyte, then the optimum point whereas best absorption of the naphthol by the fiber takes place may be missed, and hence the affinity of the naphthol for the fiber is reduced. The particles of the naphthols, which are converted into a physical condition wherein their magnitude is considerably increased, are then no longer able to penetrate through the walls and capillary passages of the fiber and hence the shade of color produced is weaker. Furthermore, another disadvantageous condition arises due to the fact that under these circumstances the naphthol lies on the surface of the fiber rather than penetrating into its internal structure with the result that the fastness of the dyestuff to rubbing is materially reduced.

The Aging of the Solution of Naphthols

Another characteristic typical of colloidal solutions, which is also manifested by the solutions of naphthols of the AS series, is aging. In this case the conditions are somewhat complicated, as we are here concerned not only with mere physical changes, but also with changes which possess a chemical character. As is known, formaldehyde is added to solutions of naphthols where a drying of the bottomed material needs not take place immediately, as in the case of piece goods dyeing, but where the bottom cotton goods are developed in the wet condition.

It has been found from experiment and study that bottoming with solutions of the naphthols of the AS series becomes very sensitive to the action of the carbon dioxide in the atmosphere after the solutions have been permitted to stand for a certain length of time before being used. The sodium salt of the naphthol is gradually converted into the free naphthol, which is much more difficult to couple with the dyestuff and as a result thereof spotty and streaky dyed cloth is obtained.

The Use of Formaldehyde

It is known that this disadvantageous phenomenon can be remedied by the addition of formaldehyde to the bottoming bath. It is not yet possible to say just what is the nature of the action of the formaldehyde on the molecule of the AS naphthol, as the compounds that are formed are too unstable and too difficult to analyze.

It must be assumed that loosely combined compounds of formaldehyde and the naphthol are formed, which, however, leaves open the ortho position on the naphthol molecule to the hydroxyl group which is necessary for coupling with the dyestuff. When such formaldehyde-naphthol solutions are heated to the boiling point, they cloud up due to the precipitation of an insoluble substance which no longer possesses the power of coupling with a dyestuff and whose ortho position is occupied. When the Naphthol AS solution ages, the two phenomena work against each other.

The aggregation of the molecule, hence the lessening of the degree of the dispersion of the solution, and the final precipitation of the dissolved substance, a phenomenon found in the case of all colloidal solutions, and the chemical transformation described above can take place very rapidly at the boiling temperature, but only gradually at ordinary temperatures. Furthermore, these actions take place with different degrees of rapidity in the case of the different naphthols.

Naphthol Solutions Can Be Kept for Short Time Only

The result is, as has been noticed in the past, that naphthol solutions can be kept only for a certain definite length of time before they spoil. Each type of naphthol solution has, therefore, a limited length of life, and this limit is influenced by two factors, namely, the degree of the dispersion when the solution was first made and the rapidity with which the chemical changes take place.

In this respect the individual naphthols may be arranged in a series which corresponds exactly to the one given above in comparing the degree of dispersion, size of particles and magnitude of their substantive powers. Hense, the solution of Naphthol AS-SW has the shortest life before it decomposes, and the solution of Naphthol AS has the longest life.

While up to the present time no means have been devised which have any effect on the progressive chemical decomposition of the derived naphthol in combination with formaldehyde, it is nevertheless comparatively easy to prevent the physical change that can take place in the solution of this compound. This change is commonly known as the "aging" of the solution, when speaking of colloidal solutions. Hense, in the case of the more insoluble naphthols, it is important from this standpoint to prepare the solution in the first place in as high a degree of dispersion as possible, and, furthermore, to maintain the original high degree of dispersion as long as possible by the addition of suitable materials. Both effects can be attained by the addition of suitable protective colloids, of which Turkey Red Oil and gelatine are the most important and give the best results.

The Use of Protective Colloids

The addition of Turkey Red Oil to the solutions of the various naphthols of the AS group increases the degree of dispersion of the solutions. The solutions

which appear to be microscopic in character, when mixed with Turkey Red Oil immediately clear up to a considerable extent. In other words, the particles of the naphthol appear to be in a higher state of dispersion in the case where the Turkey Red Oil is added than where is it not. The Tyndall cone effect is clearly weaker in the case of the naphthol solution containing Turkey Red Oil than in that of the solution which has been prepared with the aid of caustic soda lye.

However, the Turkey Red Oil plays a very important role in the preparation of the Naphthol AS solution. Then, if formaldehyde is added to a solution of the naphthol in caustic soda, in accordance with the inherent properties of the individual member of the Naphthol AS series, a clouding-up of the solution takes place with a greater or lesser degree of rapidity and soon thereafter precipitation ensues.

The addition compounds, which are formed between the naphthols and formaldehyde, are much more insoluble than those formed from the naphthols without the addition of formaldehyde. This is particularly clear in the case of the Naphthol BO. However, if the solution is prepared with caustic soda and if Turkey Red Oil is added, then the addition of the formaldehyde does not cause a precipitation of the naphthol derivatives. The formaldehyde compounds that are formed under these conditions are maintained in a colloidal state in the solution by the presence of the Turkey Red Oil ingredient. In other words, in this case the oil acts as a protective colloid.

The Use of Gelatine Solutions

The protective action exerted by Turkey Red Oil is considerably strengthened by the addition of a solution of gelatine or glue. The addition of approximately two or three grams of gelatine per liter of the naphthol solution—the addition of the gelatine is best made when preparing the paste with Naphthol AS or other members of the series mixed with caustic soda lye and Turkey Red Oil—bestows such a high degree of stability on the solution that the latter remains in a perfect colloidal condition for all practical purposes, and during any process in which the solution may be employed. The solutions of the naphthols remain in a perfectly unprecipitated condition until the chemical conversion eventually takes place whereat the maintenance of the colloidal state is no longer necessary. For example, solutions of Naphthol AS-BO, which contain formaldehdye and which are made in a concentration of seven gram per liter with caustic soda lye and Turkey Red Oil, will remain stable over a period of three days. On the other hand, when two grams of gelatine are added per liter, then the solutions were observed to remain unchanged over a period of two weeks.

What has been said above regarding the colloidal chemical character of the Naphthol AS solution as well as of the other members of the group has been fairly general. At present no very accurate data on the subject is available, but it is hoped that such information will be available in the near future. The study of the matter along these lines is not without considerable advantage to the technical man, for it gives him an idea of what happens to the materials that he employs in his dyeing process. The more thorough and scientifically accurate the explanation of the chemistry of the processes that take place in the dyeing of textile fabrics, the less chance there will be of the occurrence of errors therein and the more uniform the results are likely to be. In other words, the dyeing process will be based on a firm scientific foundation. Its empiricial character will be lost.

The Naphthols Themselves

[*The author finishes the article with a description of the different naphthols and their properties. The following account is an abbreviated translation of the matter contained in the original article.—Trans.*]

There are in all five naphthols in the group. The first naphthol and the prototype of the group is Naphthol AS. It has been called the normal naphthol, whose combination with the various dyestuffs with which it is used possesses properties also possessed by all the other naphthols of the series.

Somewhat later the Naphthol AS-BS was developed. This can be considered as a sort of "nuancing" naphthol. It is very seldom used alone, but mostly in admixture with Naphthol AS, in order to shade to a blush tint the reddish tone of the colors produced with the latter. As far as fastness to light is concerned, the colors developed with the aid of this naphthol are somewhat less effective than those developed with the aid of Naphthol AS. On the other hand, it gives colors more stable to discharge dyeing and hence it is used under those conditions.

Naphthol AS-BO is a special product employed to obtain colors with a Bordeaux tint. The colors produced with this naphthol are even better than those produced with the aid of Naphthol AS as far as fastness to light is concerned.

Naphthol AS-RL is a special naphthol, which is employed for the production of reddish colors with Turkey Red Oil which are very fast to light. It is used very largely in combination with new Fast Red RL dyestuffs. As far as fastness to light is concerned, the colors produced in this manner are best of all the naphthol developed colors. The Naphthol AS-RL colors are also very valuable for the development of clear, light fast, rose red colors.

Naphthol AS-SW, which is the last of the naphthol series, is a special product used for the production of black tones. This naphthol is a new product and probably has not yet come to the attention of the American dye man. So far as can be seen at the present time, it is probable that the new naphthol will also find use in the development of fast bluish red colors. After considerable investigation and experimentation, it is reported that it was finally possible to produce fast black shades with this naphthol and Fast Black LB dyestuffs. The black shades were found to be fast to light as well as to chlorine.

Things Every Textile Chemist and Colorist Should Know

[*Note—Under this heading there is being published, as a more or less regular feature, the discussion of certain fundamentals which should be a part of every textile chemist's and colorist's working knowledge. It is hoped that such discussions will instruct and interest some of the younger readers, and serve as a review for those of broader experience and knowledge.*]

No. 11—The Classes of Vegetable Fibers

THE vegetable fibers that are used in textiles, not including all types of ropes and cordage, are of two main classes—seed hairs and bast fibers.

The common example of the first, and the only one used to any great extent, is cotton. The single cotton fiber is a seed hair, and the name cotton hair is preferred to cotton fiber, for botanical reasons, by the British Cotton Industry Research Association, and is used throughout their publications, although the term still appears to us as unusual.

The fiber is simply one of 8,000 hairs growing on a single cotton seed (Egyptian). Each fiber is a complete unit attached to the plant only at its base, for each is a separate plant cell.

It is the only fiber of its shape, a flattened tube, and the only fiber with twists, or convolutions as they are more correctly called, for they are not twists like those in yarn, running around and around the axis, but some turn one way and some the other; on pulling the hair out straight, part of the convolutions run out and come back again on releasing the tension.

The dimensions of the cotton hair vary somewhat, but in the ordinary grades of commercial staple are of the order of 1/1200 inch in diameter and an inch long. Better grades are a little longer, but the very best of cotton is rarely 2 inches.

Flax, or linen, in the form of the pure fiber is chemically indistinguishable from cotton, and this in spite of the fact that it grows in an entirely different way, for flax is a typical example of the class of bast fibers.

Bast fibers are those which grow in the outer layers of plant stems. The fibers themselves are individual plant cells, but they are laid down in the stem very close together; in fact, they are so tightly packed that the shape, which might naturally have been cylindrical, is more nearly hexagonal.

In the plant the fibers are covered with a very thin "bark" and are cemented together by the so-called flax gum so that they form one continuous sheet covering the whole stem and its branches.

Retting, which is usually a natural or assisted process of fermentation, loosens the fibrous layer from the woody part of the stem and softens the pectinous binding material so that the fibers split apart to some extent. Long shreds of them can be easily pulled off.

The process of working up the dry retted flax consists of "breaking" the woody stem, scutching it out, and heckling the resultant bunches of fiber to comb them out still straighter and finer. The flax is kept in bunches of parallel fibers, but what appear to be fibers are all actually fiber bundles, much larger than the separate units, which are still quite closely held together. The operations mentioned, and the following processes of drawing and spinning, tend to a still further subdivision of the fiber bundles, but even bleaching does not break down the flax, which by this time is linen thread or cloth, completely to separate fibers.

The structural elements are usually a little longer than cotton hairs, averaging 1 1/5 inches. They often appear very much larger and longer, because, as we have said, they are still groups of fibers.

Hemp—i. e., Italian hemp and American hemp, which are practically species of flax and are used extensively mixed with flax for linen threads and other goods, or used separately for similar purposes—grows just like flax, except that the plants are much larger and the fiber bundles are longer and more coarse. The ultimate fibers measure about an inch, but the fiber units in commercial textiles are really bundles.

Hemp is handled in preparing and manufacturing in about the same way as flax. In fact, the same general principles apply to most bast fibers.

Jute, another common bast fiber, grows a little differently, but is on the market as fiber bundles, either put up in a long parallel form or in a loose mixed-up state as tow. The bundles are from 4 to 7 feet long and the fiber is often very light in color.

The fibers measure only 1/20 to 1/5 inch long when split down to their ultimate size. This is one reason why jute goods are seldom bleached. When the cementing materials are removed, the larger fibers go to pieces.

Jute differs from all the other fibers in being a lignocellulose; that is, a more woody fiber in chemical nature, although not in appearance.

Ramie is a relatively little used fiber, but has the same interest. It comes from a species of stingless nettle. It is also a bast fiber, strong, durable and exceptionally long and fine, but lacking in some of the properties that are important in textile manufacture.

Potash—Twin of Caustic Soda

(From a Bulletin issued by the Cowles Detergent Co.)

WITH the improvement of business conditions in Germany, potash is again finding its way into the channels of trade.

Due possibly to its long absence from the textile supply market, potash is regarded with some curiosity, and in some quarters is apparently being sold under conditions which do not give the buyer the right idea of its properties. This bulletin is prepared, therefore, as a part of the series of Cowles Detergent papers on Scientific Washing to help laundryowners place a correct value on potash, when considering the purchase of supplies for the washroom.

What Potash Is

The term "potash" is an abbreviation of the full name. "Caustic potash" is the correct name.

> *Caustic*—burning; hot; corroding; corrosive; cutting; a substance which burns.—Webster.

The word "caustic" is an adjective which describes anything having the above characteristics. "Caustic" need not necessarily be an alkali such as is familiar to textile men. For instance, there is lunar caustic, or in other words, silver nitrate. This material is labeled a caustic because of its corrosive or burning character. Lunar caustic is used largely for cauterizing wounds.

All caustic materials are caustic in effect—burning; hot; corroding; corrosive; substances which burn. This definition applies to caustic potash just as correctly as it applies to caustic soda, the more common caustic material in America. The outstanding characteristic of both these compounds is corrosiveness, no matter whether the caustic compound be soda, potash or silver. It is impossible for the user of potash to escape the same destructiveness which follows the use of caustic soda. Potash is no less destructive and no less desirable for washing purposes than caustic soda. The user of either is "playing with fire."

What Potash Will Do

The alkali used in washing works almost wholly through chemical action in the removal of dirt. Caustic potash and caustic soda are absolutely alike in their chemical reactions. The speed with which caustic potash works, however, is a little greater than that of caustic soda and therefore the destructive action progresses faster. The user of potash, in other words, is headed for the same trouble which accompanies the use of caustic soda, but he is likely to get there sooner.

The combination of heat plus air plus caustic potash or caustic soda is one of the fastest producers of damage which can be used. Textile mills which treat tons and tons of cotton goods take every precaution to keep air out of the kier in which the goods are undergoing alkali treatment. In the washwheel, however, air is always present to encourage harmful action by the heat and caustic, a very serious condition from the standpoint of the effect on the goods being washed.

Caustic potash and caustic soda are notable lint producers. Due to the extent to which a solution of caustic potash or caustic soda soaks into the surface of each tiny fiber of the cloth, rinsing becomes a problem where these caustic alkalies are used—a problem that invariably leads to the well-known evils of unrinsed alkalies.

What Geography Has Done for Potash

Potash usually costs more money than caustic soda for the simple reason that most of it is imported. You pay the freight across the Atlantic Ocean, the duty, the handling charges, and the importers' profit—all this to obtain a corrosive alkali.

It is well to understand why caustic soda is common in this country, while caustic potash is common in Germany. The explanation for this is that in Germany large deposits of potassium chloride have been discovered while in this country correspondingly large beds of sodium chloride were discovered. Sodium chloride and potassium chloride are the raw materials from which caustic alkali is made. It may be that there are large beds of potassium chloride somewhere beneath the United States and that eventually they will be discovered. When that day comes, caustic potash will lose its novelty and it will then be as common as caustic soda. Textile men will also more generally understand that the two caustic alkalies are interchangeable so far as practical results in the washroom are concerned.

This interesting fact in mineral geography has resulted in the state of affairs where American alkali consumers look upon potash as a more or less mysterious article. One readily understands that unscrupulous sales interests could promote the idea that it has unusually valuable properties. As the truth becomes more generally known, the use of potash will be considered in its rightful light and dyers will not be any more interested in its use as a detergent than they are in caustic soda because of the serious weakening of cloth which these two raw alkalies bring about.

How Potash and Soda Compare

Compounds of potassium and compounds of sodium are equivalent to each other in the series of alkali compounds. Readers of the papers on Scientific Washing have already learned that there are three bases, so-called, as a source of alkaline detergent compounds. These three are sodium, potassium, and ammonium. Potassium forms about the same series of compounds as does sodium. Technically speaking, however, while potassium compounds work somewhat faster in chemical reactions

(*Continued on page* 601)

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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THE FABLE OF THE FAST DYE

IN the last issue of The REPORTER there appeared a news report based upon information circulated by a firm of patent attorneys which informed our readers that American textile manufacturers are mobilizing an array of new trade-marks for their products. All of these trade-marks, the article stated, are intended to convey the message that the fabrics sold under them are dyed with permanent colors. According to the article, this sudden "mobilization" of new trade names is caused by the anticipated reduction in the tariff on dyes which is scheduled to go into effect on September 22.

Unfortunately, this report was so worded that it laid itself open to misinterpretation. Some who read it may possibly have received the impression that when the duty on dyes is lowered the American market will be swamped with fast German dyes. "The American manufacturers," the article declared, "are endeavoring to steal the German thunder before it begins to reverberate."

There will be no thunder when the dye duties drop. The lowering of the tariff will not cause any great change in the quantity or quality of dye imports. Regarding this very point the new Census of Dyes says: "The reduction will probably not greatly affect the larger tonnage of colors produced in the United States, nor is it probable that it will seriously restrict the dye industry, as the 15 per cent reduction is a minor factor when compared with the protection afforded by other provisions of the act."

German dyes—fast dyes and those not so fast—have been imported through the port of New York every day for years. Those same dyes, with perhaps slight variations from time to time, will continue to be imported after the tariff drops. There will be no sudden deluge of fast foreign colors. Every American dye manufacturer knows the full range of foreign dyes; he knows what they can do. He also knows their American equivalents and knows what *they* can do. He cannot be frightened by any bugaboo of "a new flood of German dyes."

Lower tariff duties may tend slightly to increase the importation of some of the higher priced competitive colors. There is, however, no reason to believe that the demand for *non-competitive* colors will suddenly jump because the duty is somewhat lowered. Demand now is not so much a matter of price as of quality. Dye consumers here have been ordering only enough foreign dyes to satisfy the special demand for them. Why should they suddenly stock up their shelves with foreign dyes when the tariff drops? Because they are *fast,* some glib person will tell you. If the implied accusation against our dyes were true, it follows that since the present tariff went into effect two years ago the American public have been wearing clothes that fade and run and turn pale at the sight of a cake of laundry soap—and all because the tariff kept out fast dyes. The simple, unadorned truth is that the dyes we have been using for the past two years are of far better average fastness than any we have ever used before—and 96 per cent of them, according to the new census, are American-made.

But this fact evidently has failed to impress its significance upon the public's mind. A deceptive untruth is being pushed forward in its place, a falsehood similar to the one fostered by certain interests eight or ten years ago. During the war a retailer who guaranteed dyed fabrics was pointed out by more conservative men in the industry as a fit subject for the psychopathic ward. But mighty few of them did any guaranteeing. "How can we," was the way they excused themselves, "when American dyes are being used?" They didn't know—or maybe they did—that many of those "terrible American dyes" originally came into this country in barrels marked "Made in Germany"; or that in many cases where they were American-made they were wool colors that had been used on cotton, or paper dyes that had been used on silk, in the dyehouses of frantic textile mills unable to obtain the proper dyestuffs and faced with a rush of orders for six months ahead.

Our dye industry kicked and fought like the far-famed Kilkenny cat to drag that thin, worn complaint about inferior American dyes into the light where the public could see the holes in it. Now the industry is being insidiously attacked on the other flank. Now fabrics are being guaranteed in wholesale quantities because, you are blandly informed, the war is over and our clothes can now be dyed with *fast* German colors.

But are they? These new textile trade-marks that are hastily being invented to convey the impression of fast color and just as hastily being patented may very easily mislead. They may serve to befog the vital truth: that the dyes now being guaranteed for fastness—over nine-tenths of them—are made right here in America.

This fast-dye bubble made its first appearance years ago when Germany, by clever propaganda insinuated into the minds of a parrot-like public, succeeded in linking the word "fast" to *all* of their dyes. This, accepted as it has been, implies a ridiculous lie—implies that the manufacture of fast dyes is an exclusive German secret, and

that all German dyes are fast. But how simple it is to tear away such a flimsy fabrication by merely pointing out that thousands of chemists in England, in France, in Switzerland, in Italy, and here in America, have been making fast dyes year after year.

We all know that there is no longer a German monopoly of the world's dye trade. But some do not yet seem to realize that neither is there a German monopoly of the secret of making *fast* dyes. While we were discussing this fact with a man whose position in the dye industry is one of undisputed authority, he remarked, rather whimsically but with seriousness beneath the whim, "We probably make some dyes as poor as the Germans, and I am inclined to believe that they make some as good as ours."

A PASSED DIVIDEND AND A QUESTION MARK

EVERY year since 1916 the American Woolen Company has continuously paid dividends to its stockholders. On September 4 the directors of the company voted to pass the regular quarterly dividend on the common stock.

For many years the American Woolen Company has made profits of enviable volume. During the war it amassed an enormous surplus. During the past year extreme conditions in the textile industry have caused shutdowns, low-scale production, even poverty. But it is almost certain that this big organization, with its tremendous volume of business, emerged from the depression with some margin of profit. Its trade, doubtless, was below normal. But its surplus has not been touched. Out of it the dividend could easily have been paid. Here are the figures:

Surplus	$33,000,000
Dividend (about)	700,000

The passing of the dividend might form a plausible argument for any contemplated wage reduction in the mills of the American Woolen Company. But William M. Wood, the president, recently declared that wage cuts were unwarranted at this time. It is probable, therefore, that no wage reduction will be announced.

It is known that the American Woolen Company is closely affiliated with the Republican party. The passing of the dividend was a thunderbolt that jolted the Republicans and evinced howls from some campaign quarters. The injury to the party is incalculable. Evidently there were no political motives behind the passing of the dividend.

The omission of the dividend was not caused by lack of funds. It probably was not caused by contemplated wage reductions. It was not caused by political motives. What was the real incentive behind the action? That is a mystery. Possibly, inside speculation. . . .

It is generally known that for over a month activities in the textile industry have pointed to an early boom. When that boom comes, the stock of the American Woolen Company will no doubt soar in value.

When the news of the vote against the dividend reached Wall Street it broke up the market. The stock dropped 16 points. Who purchased the larger part of that stock after it slumped?

If the matter of speculation was not involved, some reason other than poor business conditions controlled the vote to pass the dividend. It does not seem reasonable to believe that the stereotyped announcement emanating from the directors, to the effect that "conservative management" required the dividend cut, furnishes more than a pretext. The real reason is something else.

WILL HAND-TO-MOUTH PREVAIL?

WE have all been growling for some time about hand-to-mouth business. Cotton converters of all sorts have had their share—orders diminishing to molecular, atomic, if not to electronic, dimensions; hosiery dyers complain of a few pairs each, in a dozen to twenty different shades; silk mills have been scanning each morning's mail for something to do the next morning. The dye makers seem to have been getting mainly frantic orders for tins, in a hurry.

This small-lot or short-time buying is predicted to last so long as there is no broad and general rise in prices. As to how long this will be no one knows, and students of such subjects are not agreed. Some predict an approximately stationary level for perhaps ten years; others, a slow downward tendency for as long as twenty years; none of them seems to expect any prolonged upward movement, such as has obtained for the past twenty or more years, for some time to come.

This new general attitude is bound to have far-reaching effect, especially where manufacturing facilities have been so extensively overdeveloped as has been the case in this country in the last few years. Recognizing its permanence as based on fundamental economic grounds, the most sensible plan will be to combat it only so far as it depends on temporary causes, and to adapt to it selling, as well as manufacturing, policies.

Buyers seem to recognize that there is more profit by quick turnovers than for the system of carrying large stocks that may have to be worked off later in bargain sales to get ready for another buying season. While this sounds simple enough from their point of view, it is not so easy for the manufacturer who has planned his plant for large-scale work and correspondingly low costs. The increase in cost is a real factor in textiles. Stock merchandise that is carried in bulk lots can be dribbled out at little extra expense, but dyeing 25-pound lots when one can just as well with the same help and overhead turn out 250-pound units becomes a very serious matter. Unfortunately, novel-

ties and seasonal goods cannot be stocked to any great extent and doled out on request.

The processor on commission is in much the same predicament. He accepts small lots for the sake of keeping his customers, and loses money on them while waiting in vain for real orders. However, such business cannot go on indefinitely without adequate price revision.

On the other hand, if this new tendency will assist in averaging the year's business more uniformly over the twelve months, and do away with some of the old seasonal inactivity and uncertainty, it will do some good to all concerned. There may also be other benefits to manufacturers, along with the reduction of the speculative element in retailing. For example, it will give domestic manufacturers an advantage over foreign and will tend to shorten credits.

In whatever way conditions finally develop, understanding the situation and recognizing the fact that it has a deep-seated cause will help in meeting it; and arrangements to handle the business so far as possible in the way the customer wants it may do a great deal toward starting the wheels and keeping them turning.

T. C.'S COLUMN

LET THE CHEMIST GROW

THE textile chemist is often confronted with the old problem of trying to lift himself by his own bootstraps. Frequently his firm has little idea of what he can do, and he hardly knows himself. He has to find his work, demonstrate his usefulness as he goes along, and create future opportunities.

Unfortunately, the selection of a career is largely a matter of luck in getting the first job, and there is not as much opportunity for choice as there should be. The lines of advance are various, but most of the openings fall into a few definite classes: work for a dye manufacturer leading to laboratory supervision, demonstrator or salesman; mill work for a dye consumer, leading to a position as dyer, foreman in some other department, like bleaching, mercerizing or finishing, or superintendent; laboratory work, supervising the testing of supplies and being of general assistance in the mill, leading to possibilities in research; and, last of all, a position already in existence in some corporation as superintendent of dyeing, which should be expanded into assistant superintendent in charge of chemical operations, laboratory and research.

The necessity for trained technical men for the positions in laboratories and as demonstrators for dye firms does not require discussion, for the duties are well known and the dye people are always on the lookout for the best men that they can find. The question of openings for technical men as salesmen has been discussed in this column, and we believe that there is a tendency to recruit salesmen from the ranks of the technically educated, although that practice still seems to be far from universal. There is a real field here for men of the right personality.

Many good and interesting positions can be reached via the mill, and the man who has the technical knowledge as well as the right pushing or driving instinct so necessary to get production can advance with reasonable rapidity.

Assuming that the prospect has not by accident or design gone into one of these first two lines, he gets into somebody's laboratory and starts with routine tests of supplies, control tests and trouble chasing. To understand the big things, as well as the little things, is the only way to understand textile chemistryistry. Every new chemist entering a mill ought to spend part of his time in the milll, whatever his ambitions, for that is the only way to see all sides of the problems.

The mill point of view is necessary for success in any kind of laboratory work relating to mill production. The plant ideas are to be understood and appreciated, although they must not be adopted bodily as the most desirable policy.

Research has been ably and frequently enough discussed. In many plants it will offer opportunity for the chemist to grow. "Ideas are relatively cheap, but it needs a master mind to make a coherent story or useful structure from them." Results that can be measured in dollars will bring proportional rewards.

There are many openings for chemists, but our purpose has been to lead up to a type of position not like any of those covered but involving features common to several of them, a type that is not yet widely appreciated or often realized in practice and one that seems to be applicable to any textile plant of good size. There is a growing field for a new kind of technical executive to function with the business and financial heads. It is a position that covers too much ground to bear a simple title and one that requires nearly the same training as all the others put together.

It covers the following list of duties and is based on the idea that they are all so closely related that they should be under one responsible head: General supervision of the laboratory and of all other testing operations and appliances that may be scattered about the plant; supervision, with authority enough to determine policies, over the dyehouse and all other departments that involve chemicals or chemical operations; supervision of any research work that may be undertaken. There will be men to operate the laboratory, the dyehouse and other departments that have chemical features, and the function of the new executive will be to tie them all together and, acting through the general superintendent and in close contact with the management, to regulate these different

departments and shape their policies toward the greatest general good of the whole corporation.

No plant will rearrange its organization in this way merely because someone suggests it to them, and it will be a long time, possibly, before many of them are so organized; but it is an ideal to work for, and more will undoubtedly be accomplished by the chemist making good wherever he is and, on the basis of accomplishment, taking over the other functions as opportunity may present itself, strictly because he can handle them better than anybody else.

Is not such a position the ideal one for the textile chemist, carrying a fair amount of authority and (we hope) a salary in proportion and offering an incentive to keep up with both theory and practice in his chosen profession? T. C.

CORRESPONDENCE

Editor, AMERICAN DYESTUFF REPORTER:

Dear Sir—In your issue of June 30th we note an article on the dyeing and finishing of cotton piece goods

After reading this article carefully and noting the sketch for continuous dyeing machine, we are led to make the following criticism:

The article in a general way is correct as to handling the goods and preparing them for the dye bath, but we do not think the sketch of the continuous machine is up to date at all, and might lead some of your readers to arrange a machine in this manner in which case they might run into trouble.

We have had considerable experience with piece dyeing with sulphur colors and a continuous machine, and we have found that the more concentrated we can get the dye bath, in as small a compartment as possible, the better results we obtain.

The illustration shown on page 422 shows two dye tubs to put dye liquor in, giving the cloth two dips and two squeezes before being taken up in the air for oxidation. We have found that one dye tub, with a 3-roll squeeze, is much better than trying to use two tubs and squeezing twice, as we get a much more level shade and can handle the dye bath more efficiently.

We note the writer of this article also states that after the aftertreatment of bichromate of soda, copper sulphate and acetic acid, the material is then plaited on trucks and conveyed to the squeezers, where it is washed and made ready for the drying cans.

We find a much more efficient process is to add one or two wash boxes to the machine, and do all this in one operation, so that when the goods leave the continuous dyeing machine they are all washed and ready for the dry cans, thus saving considerable handling.

H. O. DAVIDSON,
Vice-president, Eagle & Phenix Mills, Columbus, Ga.

RECENT LITERATURE

THE 1923 DYE CENSUS

The 1923 Census of Dyes and Other Coal Tar Chemicals is an analytical and statistical classic. It is a veritable "pocket encyclopedia" of the dye industry, containing nearly 200 pages of compact information. As such it merits a leather binding and a prominent position beside previous issues on the desk of every dye man who prides himself on possessing a store of knowledge about his business. It is mild praise, indeed, merely to state that this new book contains very interesting information. It is positively an invaluable contribution to dye literature. It is the most complete census ever issued by the Tariff Commission and covers a surprisingly wide range of subjects related to the industry.

The first part of the book consist of a comprehensive summary of the industry and covers briefly the domestic production of crudes, intermediates, dyes and other synthetic organic chemicals. Part II goes into greater detail on each one of these subjects. Figures and facts are given on crude production, intermediates are described and each in turn examined as to production. Following that is a summary of dye production in 1923, which tells of the large increase in an output which totaled over 93,000,000 pounds. Factors responsible for this large increase last year are enumerated; the effect of the high tariff is explained; comparative prices are given which reveal a 10 per cent. decline from those of 1922. A table on page 34 shows the domestic sales prices of 100 dyes, from 1917 to 1923, compared with the invoice values of the same dyes imported in 1914. The relation of production to consumption and the effect of the Ruhr occupation are explained.

Regarding new dyes the report says, "An examination of the dyes for which production was recorded in 1923 shows an addition of nearly one hundred new dyes to the United States manufacturing program. These were not restricted to any one class either by chemical derivation or application." Of the reduction of the tariff duties, scheduled for September 22nd, the report states that this will have little effect on the progress of our domestic industry. A particularly interesting table shows comparative duties on variously priced competitive and non-competitive dyes imported under the present tariff; the figures in this table show plainly what the duty on these dyes will be after the rate is lowered.

The chapter on the production and importation of dyes by classes is well illustrated with tables and

charts, and will prove of great value for reference purposes during the coming year. Exported dyes are also analyzed, tabulated and charted to show our progress in foreign markets. A table following this section runs for seven pages and shows clearly the detailed production and sales of dyes and other finished coal tar products during 1923.

There is a table listing nearly 150 dyes not classified by Schultz numbers, together with certain new dyes of American development for which there are no foreign equivalent, with key numbers indicating their manufacturers. Another long table lists in one column dyes and chemicals produced, and in the adjoining column the key numbers to the manufacturers of each product, the quantity and value sold, and the total quantity produced. This part of the report also includes a section devoted to an analysis of figures for employees and rates of pay in the dye industry. Progress is research work is briefly described; regarding the value of research the report says, "The coal tar chemical industry must not only keep in view, as in the past, the development of products already known, but must always be alert to the discovery of new products if it is to maintain a competitive position in the world's markets."

Part III of the Census deals with imported dyes and gives a complete summary of imports for 1923. The total imports for the year are given as exceeding three million pounds, slightly less than for 1922. There are in this section over seventeen pages of tables giving exhaustive quality and value figures for all dye imports during 1923 with a handy index that enables one to locate any dye product listed on these tables.

The section on the international dye trade presents the latest available news, facts, data and detailed statistics relative to dye industry development, production, exports and imports of Germany, Great Britain, Switzerland, France, Italy, Japan and all smaller countries having a dye industry. The Ruhr occupation is dealt with in its relation to the dye production of the world. Tables are given showing both the world's capacity to produce dyes and exports of dyes from the chief producing countries for the years 1913, 1921, 1922, 1923. The maximum reported output is, according to these tables, 491,000,000 pounds and the estimated annual capacity 614,000,000 pounds. Another table gives imports of dyes into the chief consuming countries for the foregoing years. China heads this list as usual. Most interesting is the contrast between the figures for the United States imports for 1913 and 1923. In the former year we imported over 45,000,000 pounds of dyes. Last year the total came to but 4,000,000. An insight into dye price fluctuation is obtained when one notes that in spite of this enormous decrease in imports the value of the imports dropped only two million dollars, from $7,537,000 to $5,243,000. There are separate export and import tables for *each* dye-producing country; a stupendous task it must have been to compile these.

The new feature of this Census is the voluminous chapter on Reparations Dyes. It outlines the terms, quoting from the Versailles treaty; gives statistics of stocks of German dyes and percentages of distribution; texts of various agreements and protocols entered into relative to carrying out the reparations dyestuffs plans are also included. The appendix that concludes the work gives statistics of imports and exports of all coal tar products from 1917 to 1923, closing with a directory of manufacturers of dyes and other synthetic organic chemicals during 1923.

The Colour Index. Society of Dyers and Colourists.

The above work, eagerly awaited for some time by organic chemists as well as by the dyeing trade, is at length available in complete bound form, and deserves discriminating but hearty commendation.

Since 1921, when a committee was appointed by the Society of Dyers and Colourists to plan and issue the work, the chemical public has been eagerly awaiting the publication of the Index. The last edition of Schultz (1914; the last previous to the new edition, that of 1923, which came out while the English Index was being issued) has been none too easy to obtain, and, furthermore, has been none too satisfactory in many particulars, notably in the fact that very few indeed of the dyes manufactured outside of Germany have been even mentioned by name. This latter defect of the 1914 Schultz still exists in the new and enlarged Schultz of 1923 (see review of the latter in this journal, Vol. XIII, No. 11, p. 449).

The avowed purpose of the English Index was to satisfy this need of a more comprehensive and less haughtily nationalistic handbook of dyes, bringing the projected work up to date and filling the very many gaps in the old Schultz. We are satisfied that this end has been reached by the editor, Dr. F. R. Rowe; we congratulate Dr. Rowe and his collaborators not only upon the successful completion of their work but upon the remarkable attainment of a degree of completeness which was hardly to be hoped for even from an official publication of the Society of Dyers and Colourists. This first edition of the Colour Index is indeed a remarkable and valuable achievement.

Dr. J. C. Cain was originally entrusted with the preparation of the book, but died while the work was still in the preliminary stage. As his successor, F. R. Rowe, D.Sc., F.A.I.C., took up the difficult task of carrying on, and to Dr. Rowe's energy we owe the working out to completion of the Index. The work was first issued in fourteen parts, one per month (and how eagerly were the successive parts awaited!); and as each part was printed, 150 proofs were forwarded to dye chemists, manufacturers, etc., for correction, supplementary information and criticism. In this way

it proved possible to iron out, so to speak, more than one defect; and, above all, to guarantee that the total list of products would be complete, humanly speaking; for the manufacturers themselves gave much accurate and greatly needed information about their own products—all except the German firms! On completion of the last issued part, it was a comparatively easy task to collate the whole and to issue the complete work in one bound volume.

The Colour Index forms a large quarto, 9½ by 12 inches, and about 2 inches thick; it contains some 741 pages, and is sold, bound in cloth, for £5 15s. and in leather for £6 10s. The index is full: it covers sixty-six pages of four columns each, containing an appalling number of synonyms. About 1,316 different compounds are described in the work, and by far the greater number of these bear varying names of makers. It was originally planned to make a beginning of reducing the number of synonyms and names by listing each dye first under a standard name, in the hope that, as time passed, one manufacturer after another might see the advantage of abandoning various meaningless or fancy designations of his products and begin marketing his products under the Index name. This most certainly ought to be done, in the interests of research and reference; we venture to say that the manufacturers themselves would in the long run find it to their advantage. But the scheme, praiseworthy as it was, could not be carried out at this time, owing doubtless to lack of time; for the completion and issue of the Index was imperatively needed. We earnestly hope that the next edition will at least make a beginning in this reform.

As to the general scheme of the work, it may be described as the old Schultz expanded, improved and brought up to date. The general plan is the same: each individual dye is listed by name with its synonymy as far as known, with a running number, the old Schultz number being cited; the general (and sometimes the detailed) method of preparation, with structural formulae where advisable, is then given, with classification of the fastness properties, etc., following, together with reasonably ample space for the insertion of notes by the individual user of the book—all this in the familiar tabular form. References to the patents concerned are also given fully, as well as concise information regarding the intermediates involved in the manufacture of the dyes and notes on the use of various dyes other than as applied to fibers or fabrics, closing with a list of corrections and additions.

We have heard a few mild complaints of the rather unwieldy size of the volume. But we doubt whether this could have been obviated. For a handy reference work, such as the Index is intended to be, there must not be more than one volume; the print must be of fair readable size—as it is; the various items must be distinctly spaced—as they are; the paper must be firm and of good quality—as it is. Presumably some criticism will be made of the valuation of the fastness tests; but we think not justly, for the standards of fastness are, even now, in an undeniably chaotic and unscientific condition; unavoidably so, we feel. We have as yet no rigidly exact method of either determining or classifying fastness, and such terms as "very fast," "moderately fast," etc., are relative, and vary in value with the individual using them.

As future editions of the Index are called for, various minor changes will doubtless be made. But they must remain minor changes, for this first edition is remarkably satisfactory. The Society deserves commendation for its public-spirited assumption of the publishing of so expensive a work (it has cost the Society over $25,000) and for its wisdom in entrusting the execution of it to Dr. Rowe; and the editor himself, with all who cheerfully collaborated without financial remuneration, is to be congratulated and thanked. The book is absolutely indispensable to all dye chemists and dye laboratories, and should find place in all chemical libraries, private or public, which deserve their name.

F. S. Beattie.

NEW NEWPORT BINDER INSERTS

The Newport Chemical Works has issued two new bulletin inserts for its binder. These describe new products that have recently been placed on the market by the concern. The first treats of Posavon soap, Milling Oil-Poco and Alipsol. Posavon soap is described as a highly concentrated potassium soap and is guaranteed to be free of any kind of filler or any substance which is apt to attack the fiber. It is claimed to be a thorough and even moistening product, giving excellent softening effects, protecting the fiber from injury by alkalies and having foam developing, cleansing, dissolving and ozonizing properties. The bulletin briefly describes its use in woolen washing.

Milling Oil-Poco is described as producing a strong felting action and as furnishing a creamy fulling foam which emulsifies and keeps in solution all fats that do not saponify. It is said to prevent clotting of fibers during fulling and to protect them from alkaline influences. Its properties and important features are enumerated and its use in washing woolens described.

The second bulletin covers the uses of Pinol and Isomerpin, and gives further details regarding Posavon soap. This bulletin is in the nature of an instruction book for these three products. It details the use of Pinol in scouring and bleaching, and its use in combination with Posavon soap in the semi-silk industry and for craping or crisping cotton, half-wool, half-silk and woolen goods. Another section describes fully the use of Isomerpin in dyeing, finishing, sizing and mercerizing alone and with Posavon soap in printing with alizarine and other dyestuffs. This bulletin should prove very helpful to textile men, as the information it contains was doubtless obtained only after exhaustive tests with the products involved.

The Dyeing of Cellulose-Acetate Silk†

Chemical and Physical Properties—Evolution of Dyeing Methods—Miscellaneous Dyeing Methods—Dyeing Mixed Fabrics—Printing

By L. G. LAWRIE

CELLULOSE-ACETATE silk,* since its inception as a commercial fiber soon after the war, has been the subject of much research work, mainly directed toward its dyeing properties. Only two or three years ago it was with the greatest difficulty that a limited range of colors could be dyed on this material—excluding, of course, the dyeing of the saponified silk. But at the present time there are quite a number of distinct methods of dyeing and the introduction of this artificial silk has already given rise both to new series of dyestuffs and new dyeing methods. As several lectures have been given recently before the society dealing with different methods of dyeing (see Journal of the Society of Dyers and Colourists, 1921, p. 287; 1922, p. 162; 1923, p. 10), those methods which have already been dealt with can be treated very briefly.

Chemical and Physical Properties

Cellulose-acetate silk differs from the other artificial silks on the market in many important respects, and its properties, both physical and chemical, make it a distinctive fiber. With caustic alkalis and, to a limited extent, with strong alkaline carbonates, it is readily saponified (Monk, Brit. Pat. No. 20,672, 1910), the acetyl groups of the cellulose-acetate molecule being replaced by hydroxyl groups. The reaction is so rapid that the outside of the fiber becomes completely changed before the interior is affected, and the layer of modified cellulose thus produced around each fiber then dyes readily with direct, vat and sulphur colors in a similar manner to cotton or viscose silk. Although the acetate silk can be dyed so easily by this method, the dyeing problem is by no means solved, as saponification possesses some great disadvantages, of which the loss in weight of the material is probably the most important. The percentage loss in weight is approximately equal to the percentage of caustic soda employed; thus the silk is usually saponified with 10 per cent caustic soda on the weight of silk, which gives a 10 per cent loss in weight. To a considerable extent, the silk retains its distinctive physical properties after saponification. This treatment is carried out in practice (British Celanese Company, Brit. Pat. No. 69,741, 1921) by immersing the hanks in a hot (75 deg. Cent.) bath containing 30 per cent NaOH (76 deg. Tw.) on the weight of silk, working well for forty-five minutes, rinsing and scouring. The silk is entered hot in order to avoid the unlevel results which occur when the liquor is gradually heated. Various modifications of this process have been suggested for the purpose of slowing down the reaction by the addition of alkali silicates, borates or aluminates to the bath (British Celanese Company, Brit. Pat. No. 175,486, 1920). The method of dyeing saponified acetate silk is exactly the same as for dyeing viscose silk, but care must be taken that the temperature does not exceed 75 deg. Cent. Dyeing and saponification can also take place in the same bath by the addition of sufficient alkali together with the dyestuff, but less satisfactory results are obtained in this way.

The second important difference between this silk and viscose silk is its sensitiveness to water at or near the boil. The silk is readily affected by hot water at about 90 to 95 deg. Cent., and a few minutes' treatment with boiling water shrinks the hank and completely destroys the luster. To a more limited extent, hot ironing with a damp cloth dulls the material, but steaming has a much milder action than hot or boiling water, and steaming without pressure can be carried out for about quarter of an hour with little or no detriment to the material. This is probably due to the fact that the steam is not absorbed into the fiber so readily as hot water is in the dye bath. It has been found in practice that with the present type of silk a safe dyeing temperature is 75 deg. Cent., although 80 deg. or even a little higher can be used if considerable care is taken.

Cellulose-acetate silk is very resistant to wetting-out, and it absorbs water more slowly and to a less extent than either cotton or viscose silk. This property accounts for the fact that stronger baths than normal must be used when treating this silk, as, for instance, in diazotizing and developing.

This material has practically no affinity for the soluble salts of the metals, neither can it take up the hydroxides of the metals to any extent either as precipitates or as colloidal solutions. This is probably due to the lack of absorbing power to which attention has already been drawn. Tannic acid and many other substances which are taken up by cotton are not absorbed and retained by cellulose-acetate silk.

*In speaking of acetate silk throughout this paper the author refers to the product "Celanese" made by British Celanese Ltd. of Spondon, England.

†From the Journal of the Society of Dyers and Colourists.

Finally, cellulose-acetate shows a marked difference from other forms of cellulose in its behavior toward organic solvents. Unlike cellulose itself, the acetate is soluble in acetone, tetrachlorethane, pyridine, etc., and swells up and forms a jelly with chloroform, which latter property is stated to be a convenient test for the hydrolyzed triacetate silk.

The other main chemical reactions of this fiber are very similar to those of cellulose; it forms oxycellulose with oxidizing agents and its reaction with acids, etc., is very similar to that of cotton. It is not more sensitive to dry heat than cotton or viscose silk, either at high temperatures for short periods or lower temperatures for long periods.

Evolution of Dyeing Methods

There is now no lack of dyeing methods for this material, but there is at present no one method which gives a sufficiently wide range of shades of good fastness properties and easy application.

The first attempt at dyeing was by the utilization of those dyestuffs already on the market. It was then seen that acetate silk had no affinity for the great majority of direct and acid colors and that it had some affinity for practically all the basic dyestuffs and for the majority of the mordant coloring matters. An examination of the colors which would, and would not, dye cellulose-acetate silk, showed that two main factors governed the affinity. These were (1) most dyestuffs containing basic groups had an affinity for the fiber and (2) dyes containing sulphonic acid groups had little or no affinity. The acid character of the fiber explains its affinity for basic dyes, but the rules governing the affinity of the other colors have not yet been satisfactorily elucidated. Dyeing with basic dyestuffs is, however, not entirely satisfactory, mainly owing to the poor affinity of these colors. It has been found (Clavel, Brit. Pat. No. 182,830, 1922), that the addition of magnesium chloride, stannous chloride, etc., to the dye bath when dyeing with basic colors increases the affinity of the silk, and within the last few months the Bayer Company have put on the market a product called "Celloxane," which appears to be principally zinc nitrate and has a similar effect to that of the above-named compounds. But the range of colors which can be thus applied is not large and to obtain a full range of shades a topping process is often necessary.

It was noticed quite early that cellulose-acetate silk has a distinct affinity for organic bases such as dianisidine, α-naphthylamine, benzidine, etc., and consequently "ice-colors" can be formed on the fiber by diazotizing and developing these bases. Such colors are easy of application and capable of producing a wide range of shades of excellent fastness to washing, but the usual method of applying them to cotton, that is, by padding the material in the naphthol first and then passing through the diazotized bases, is not applicable to this material, owing to its poor affinity for the naphthols.

On reversing the usual process and applying first the bases from solutions of their hydrochlorides, fairly satisfactory results were obtained, but it was found that in many cases quite different shades were obtained and the bases appeared to have a considerably increased affinity when they were dyed as free bases, instead of as hydrochlorides. This increased affinity is sufficiently strong to produce blacks on development with β-oxynaphthoic acid from such bases as benzidine, tolidine, ρ-ρ′-diaminodiphenylamine, etc., even when dyed in a cold bath. The acetate silk can be dyed in this way either by making up the bath with the soluble hydrochloride of the bases and adding sufficient alkali to neutralize the bath, or by applying the base itself by means of a dispersing agent. Cassella & Co. have recently put bases on the market for dyeing the silk under the name of Azonine colors. Azonine 2R for instance being amidoazotoluene base.

The method of dyeing the silk with bases in suspension in the dye bath is not entirely satisfactory, and attempts were made to render these bases soluble and at the same time retain their affinity. A. G. Green solved the problem when he introduced the Ionamines, which are basic compounds rendered soluble by the addition of an ω-sulphonic acid group (see Journal of the Society of Dyers and Colourists, 1923, p. 10). These compounds are easily soluble and on the addition of acid or alkali, or sometimes by merely heating in the dye bath, they are hydrolized with the liberation of the original base from which the Ionamine was prepared. These dyestuffs possess the important properties of having good affinity and giving a useful range of shades. Further, the majority can be diazotized and developed on the fiber with the formation of insoluble azo compounds, which in most instances are of very good fastness. The developers generally used are of the naphthol class, as the amines, α-naphthylamine, ρ-phenylenediamine, etc., themselves have an affinity for the silk, and the shades are consequently duller and are apt to rub. The Ionamines have practically no affinity for cotton, but they dye wool like acid colors with little or no hydrolysis. There are at present six Ionamines on the market, Ionamines A, B, H, L, MA and KA. Ionamine A when diazotized and developed with β-oxynaphthoic acid gives a deep black of very good fastness properties; Ionamine B and L give shades ranging from orange to blue when diazotized and developed with resorcine, β-naphthol or β-oxynaphthoic acid; "H" gives a greenish-yellow direct and is also capable of diazotization and development, while Ionamine KA is a direct dyeing Ionamine only.

The Badische Company also have recently patented (Brit. Pat. No. 204,280, 1923) a series of the bisulphite compounds of difficultly soluble or insoluble azo coloring matters as dyes for acetate silk. In other words, they have coupled similar bases to those used in the Ionamine dye with suitable developers and made the resulting insoluble azo colors soluble by converting them into bisulphite compounds.

Another early observation was that cellulose-acetate

will dye from baths in which the dyestuffs were not in solution, in fact, many colors which would not dye the silk when in solution showed a marked affinity when finely precipitated in the bath. The results so obtained were, however, not very satisfactory, the dyestuffs in many cases being only superficially fixed and rubbing-off badly. However, certain colors, such as Spirit Red III, can be dyed satisfactorily in this manner. A considerable improvement in this method of dyeing was the suggested addition of protective colloids to the dyebath containing these insoluble suspensions, which gave more level dyeings and better penetration (W. Harrison and Burgess Ledward & Co., Brit. Pat. No. 179,384, 1921).

A considerable step forward was made when it was found by the British Celanese Company that certain colors —simple amidoazo bodies—could be "dissolved" with such colloidal substances as Turkey Red Oil and other colloidal bodies, and the resulting mixture poured into water gave what appeared to be a true color solution, but was in reality a highly dispersed colloidal solution. Such dispersed colors were found to dye the silk well and this method, which can be called for want of a better name, "Dispersion dyeing," is capable of extended used. This novel dyeing process has its own peculiarities. The method of mixing the dye with the dispersion medium varies somewhat according to the dyestuff used, some requiring to be boiled, while others will go into solution cold. When poured into water—a more satisfactory procedure than that of adding water to the paste—they appear perfectly clear in the majority of cases; a few colors, however, become cloudy and remain in this condition when heated. Again, the most stable "solutions" appear to be those prepared cold and afterward heated, instead of pouring into the already hot dye bath. When using Turkey Red Oil as a dispersing agent, the dye bath must be neutral or alkaline, but by the use of highly sulphonated castor oil, acid dye baths may be employed, which in many cases is an advantage. Dyeings made by this method show, on the whole, excellent fastness to washing and rubbing; their fastness to acids, alkalis and light vary, as do the properties of the similar compounds applied as Ionamines or those rendered soluble by one of the already mentioned methods. An addition of salt can be made to the dye bath and in many instances heavier shades result, but there is a tendency under these circumstances for the dye to be superficially fixed.

Other dispersed colors can be used besides these amidiazo bodies made specially for this process, such as Spirit Yellow I, Monolite Fast Scarlet R, Spirit Red III, as well as such bases as dianisidine, tolidine, benzidine, etc., which are taken up very readily and can be diazotized and developed on the fiber with various developers. The bases of many basic colors also can be applied by this means as well as such colors as Quinoline Yellow Base, Indophenol, etc., while, although of little practical importance, it is interesting to find that nearly all colors capable of dyeing cellulose-acetate can be dyed to a greater or less extent with addition of one or other of the various dispersion media. Colors having no direct affinity for the silk, such as direct and acid colors, cannot be dyed in this way.

A recent departure in connection with this method of dyeing, patented by British Dyestuffs Corporation Ltd., is the introduction of a series of colors already dispersed in a special dispersion medium. The stability of these dispersed colors in solutions of dye bath strength is remarkably good, some of them being capable of standing several days without any signs of precipitation.

The range of these "Dispersol" colors has been still further extended by the recent addition of amidoanthraquinone dyestuffs, in this way giving a range of colors possessing the excellent light-fastness of the anthraquinone series. Ionamine dyestuffs have also been prepared from similar anthraquinones.

Dyeing with these dispersion colors is carried out in the usual manner at a temperature of 75 deg. Cent. for about three-quarters to one hour, when the majority will be found to have exhausted well, the affinity of this class of color being quite good, but somewhat inferior to that of the Ionamine range.

The lack of affinity of dyestuffs containing sulphonic groups was remedied when it was found that amidoazo, substituted amidoazo, and other dyestuffs could be rendered soluble by the introduction of carboxylic acid groups, the resulting compounds having considerable affinity for cellulose-acetate. The shades produced are similar to those of the Ionamines, and such of the dyes as contain a free amino group can be diazotized and developed on the fiber. These dyestuffs have been patented by British Dyestuffs Corporation Ltd. (Brit. Pat. No. 202,157, 1922).

Clavel, in Brit. Pat. Nos. 182,830 and 182,844, 1923, formulates the theory that the affinity of direct dyes for acetate silk is due to the presence of certain active groups which, if present in the absence of sulphonic acid groups, or if preponderating in the presence of one sulphonic acid group, are capable of dyeing acetate silk. Many exceptions can, however, be found to the latter statement, as, for example, Azo Acid Blue 6B (By), Azo Fuchsine B (By), and Acid Alizarine Black R (M. L. B.). Moreover, a hard and fast rule based on chemical constitution is difficult to lay down, as other factors, such as the size of the molecule and the state of aggregation, play an important part.

G. H. Frank, of the British Dyestuffs Corporation Ltd., continuing this work, finds that the position of the sulphonic acid group in the molecule is a factor in determining the affinity for acetyl cellulose, and patents are pending.

Miscellaneous Dyeing Methods

The use of such substances as ammonium thiocyanate (Briggs & Palmer and British Cellulose Company, Brit.

Pat. No. 158,340, 1919) was another early suggestion. These substances have a certain action on the fiber which renders it more capable of absorbing and retaining soluble dyestuffs otherwise having no affinity for the silk. The results are not entirely satisfactory, and this method of dyeing has not been used to any great extent.

A satisfactory method of dyeing acetate silk with Indigo is to dye in a vat containing Indigo White together with a little glue and a small quantity of hydrosulphite and ammonia. Deep blue shades of fairly good fastness may be obtained.

Indigo can be superficially applied by means of a suspension in water, when the color is taken up to a certain extent if the dyestuff is in a sufficiently fine state of division.

Dyeing with Indophenol can be done in a hydrosulphite-caustic-soda vat, using such small quantities of the alkali that practically no saponification takes place. A vat is made up containing 10 parts of Indophenol to 1 part of caustic soda (76 deg. Tw.) and 7½ parts of hydrosulphite. This gives a good deep blue shade, but suffers from the disadvantage of being very sensitive to acids.

Aniline blacks can also be easily produced on the fiber either as dyed or as aged blacks and satisfactory results are obtained.

Dyeing Mixed Fabrics

The dyeing of union materials composed of cotton and cellulose-acetate silk is not difficult, and attractive contrast color schemes can be obtained by means of a simple one-bath process. This is due to the fact that the majority of direct colors have no affinity for cellulose-acetate and large numbers of cellulose-acetate colors have no affinity for cotton. By a judicious selection of suitable colors, either solid shades or contrasting or shot effects can be obtained in one bath, and almost any desired combination or solid shade can be obtained by a two-bath process. The following examples will illustrate this type of dyeing: Solid shades of yellow can be obtained by dyeing the union material with Chlorazol Fast Yellow 5GK and Citronine Y Conc.; brown can be obtained with Alizadine Brown M, Chlorazol Brown M and Chlorazol Brown LF; blue with Chlorazol Sky Blue GW and Prune Pure; while a black can be obtained with Cellutyl Black R—a special mixture for the dyeing of cotton and acetate silk hosiery in one bath and subsequently diazotizing and developing with β-oxynaphthoic acid. As examples of contrast effects, a gold on a black background can be dyed by means of Ionamine B direct and Chlorazol Black GF; red and green with Chlorazol Fast Scarlet 4BS, together with Prune Pure and Citronine Y Conc., etc. Dyeings on viscose and acetate silks are capable of producing some beautiful effects.

Mixtures of wool and cellulose-acetate silk present a difficult problem to the dyer owing to the fact that, although there are many colors which dye wool without staining the silk, practically all the dyestuffs capable of dyeing acetate silk also dye the wool and usually dye it a different shade from that on the silk. The Ionamines dye the two fibers quite differently, going on to the wool like acid colors without hydrolysis and on to the silk as a base. On diazotization and development the differences become more marked. Those acid colors which dye cellulose acetate direct also dye the two fibers different shades, thus Citronine Y Conc. gives a greenish yellow on the artificial silk and a reddish yellow on the wool, Cardinal Red J a pink on silk and a full red shade on wool. On the other hand, Tannin Pink C, a basic color, dyes the wool at the expense of the silk, which is left practically white. Magenta and Malachite Green are two basic colors which will dye both wool and acetate silk approximately the same shade, but in each case the wool is dyed more deeply than the silk.

With the "dispersion" colors, however, the wool, although dyed to a certain extent, is usually about the same shade as the silk but much weaker, so that by the addition to the bath of suitable acid colors, solid shades can be obtained. One or two of these "dispersion" colors give good solid shades when used alone. Also, by manipulating the temperature of acidity of the bath, the color can to a certain extent be forced on to the wool for the production of more uniform dyeings.

Acetate silk effect-threads can be used on cotton, viscose, wool, etc., and remain unstained when suitable dyestuffs are employed, but most dyestuffs contain small quantities of other substances which stain the cellulose-acetate silk, and a range of colors from which these impurities have been eliminated are on the market under the name of C. R. (Cellanese Resist) colors.

Printing

The printing of this material is much simpler than dyeing and a large variety of effects can be obtained by suitable modifications of the dyeing processes already mentioned. If cellulose-acetate silk is printed with caustic soda and then steamed, a local saponification takes place without any appreciable loss in weight or alteration in the appearance of the fiber. This printed material can then be dyed with direct, sulphur or vat colors which, having no affinity for the acetate or non-treated portion of the fabric, give a colored pattern on a white background.

The Ionamine colors can be printed directly on to cellulose-acetate silk and give fairly good shades, but in the majority of cases they are of only moderate fastness to washing and of very little practical interest in view of the ease and simplicity of the following method:

This process is the printing of direct crimping colors and other cotton colors directly by means of caustic soda, forming, as with the plain caustic soda print, a slight, but sufficient, superficial saponification which allows, if necessary, of quite deep shades being produced on the material. A good range of direct colors can be

(*Concluded on page* 606)

Vegetable Matters Used in Dyeing Cotton Goods

Theory of Color—Comparative Fastness of Coal-Tar and Vegetable Dyestuffs—Tannins: Their Source, Properties and Action—Sumac—Catechu—Cutch—Gambier—Dyeing Processes Used

By W. B. NELSON

[EDITOR'S NOTE.—*This is the first of a series of articles dealing with the vegetable dyestuffs used in dyeing textiles. The author is an experienced dyer and colorist of "the old school" and his writings will no doubt prove of interest to those who are still using the older natural dyes.*]

IT is our intention in the present paper to show that while the direct colors are very valuable for the dyeing and coloring of some classes of work, there are certain practical results which cannot be attained by them. This is particularly true when various climatic conditions are involved; results obtained are of a very uncertain character if the dyed materials are intended to be used in damp places where rain, dew and sunshine alternately are factors influencing their permanency. Take hay caps, for instance; they have to be dyed brown and must stand at various times the elements named above. No one would attempt to dye these with direct colors, which induce mildew, but would use the vegetable cutch, which, with the mineral copper with which it is combined or mixed and the mineral chrome with which it is raised, is preventive of all wear and tear, as well as of all mildew and weather stains, although it may not be so fast, temporarily at least, to the elements—rain, dew, sunshine.

It is shown in this paper that vegetable matters are better than aniline matters for some purposes, so far as colors go, and it may be well for us, momentarily at least, if we look into the usually accepted theory of the formation of color on dyed cotton substances.

It has been found by science that color is not a material thing but a sensation, and dependent entirely upon the way or manner that we look upon things. Strictly speaking, colors have no material existence but are altogether the effect of light; at least, colors do not exist in the object appearing colored, but in the light that is reflected from the apparently colored object.

According to the above, then, we shall see that all the waves of a white light, for instance, are vibrating together and that they are all composed of different colors. Now, when these waves strike upon the surface of any substance they may all be reflected from that surface and become white; or it is possible that they become absorbed in the aforesaid surface, in which case they will become black or will have a very dark brown appearance. Now, between these two colors there are any number of varying proportions of color waves that may be absorbed, reflected or transmitted, so that the varieties of tint and color may be innumerable.

It is quite easy to take the spectrum as shown through a vertical slit on a glass prism and to divide it into three different parts or primary colors, in some cases called the chemical, the luminiferous and the calorific rays owing to the different properties which they possess. The blue is found to possess the greatest property of causing or exciting chemical activity, the yellow is the greatest light giver, and the red possesses the greatest heat-giving properties.

We will take these three colors for our illustrations in their most popular sense. If the colored rays are not reflected or absorbed in the same ratio the result is a color according to the difference in the reflection or absorption of the different rays or ray. If the red ray is absorbed and only the blue and yellow rays are reflected, the object from which they are reflected appears green; if the yellow ray is also absorbed the object appears blue, or if it is the blue ray that is absorbed and the red and yellow reflected the object appears orange; or if the yellow ray only is absorbed the object appears violet or purple. Therefore, if these three colors combine differently all the various shades in nature are produced. The same material may transmit some rays and reflect or absorb others; it is these innumerable shades of color that we see that are caused by the varied combinations of the unabsorbed rays of light.

FASTNESS

It is necessary, if coloring matters are to be reasonably fast and fixed firmly on the fabrics so that they will resist the influences of wear and tear, climate, etc., that they be reduced to their ultimate molecules by being dissolved in appropriate mediums before their particles can combine with the fibers of the goods. While this is a matter of mordanting, it may be mentioned here that the dyer, in doing this, must watch closely the degree of affinity between the goods themselves and the solvent used in the bath, and determine in his mind the force that the solvent will use in working against the coloring matter; otherwise the color-

ing matter will be weakened by the attraction of its solvent, and it is right here that the direct colors are likely to fail, particularly as regards fastness to climatic changes.

Direct coal-tar colors are easily and wholly soluble in water, and their attraction for their solvent and the fibers of the cloth are so nicely and evenly balanced that the goods, when immersed in a solution having only a reciprocal affinity for the color, do not extract the coloring matter from the solvent or exhaust the bath, and the depth of color on the cloth corresponds with the concentration of the dye solution. In other words, the solution of the coal-tar color and the cotton goods dyed with it are considered "in equilibrium"; the dissolved dye has just the same affinity for its solvent that it has for the goods being dyed with it, and no more, and the addition of sodium chloride and sodium sulphate to the solvent in the bath simply acts to overcome the inertia of the dyeing liquor and does not act in any way as a mordant, which is a go-between that extracts both the cloth and the solution.

We might say that the chemical or other changes which make these direct aniline colors quite undesirable as permanent colors for cotton materials shows their liability to favor mildew if the conditions are ripe for its growth, and that this liability to so favor mildew may be set down as one of their most undesirable characteristics.

If our arguments are based upon a correct appreciation of the fugitive character of the direct aniline dyes under certain climatic conditions and their liability to favor the growth of mildew, it is evident that when such goods as fish lines or nets, sail cloths, canvas, or duck for hay caps, tarpaulins, horse covers or any fibrous substance exposed to the weather or water are to be dyed, the direct dyes are unsuitable and some other process must be used. This is just exactly where the old style of dyeing, with the extract and tannin matters of the vegetable dyestuffs, comes into play again, with all its elaborate system of mordanting, aging and dyeing, involving, as it does, the combination and precipitation of insoluble and inert lakes on and in the very heart of the fibers.

Tannins

There are certain substances widely distributed over the vegetable kingdom which have an astringent taste and possess the property of giving a blue or a green coloration with the persalts of iron. These astringent substances, or tannins as they are called, when added to solutions of gelatine or albumin produce a precipitate which is a compound of the animal substance with the tannin. All these compounds resist putrefaction in a remarkable degree, those obtained with gelatine forming the basis of leather. The production of leather is not, however, the only use to which these principles have been applied, for they give colorations with certain metallic oxides and have, consequently, been among the most valuable dyestuffs, being employed chiefly for the production of blacks, grays and browns.

Tannin matters, or the commercial articles used for dyeing, being the bark, leaves, etc., of plants, invariably contain, besides the tannins peculiar to them, a certain amount of extraneous matter, such as gum and woody fiber.

Tannic acid, or the tannins—for it is the tannin matter which gives the true dyestuff—are divided largely into two different kinds, viz.: those which usually give a blue-black precipitate with persalts of iron (in this class we may mention gall nuts, Chinese galls, oak bark, sumac, divi divi, mysobalens and salonia) and those tannins which give a coloration which is green with the persalts of iron. Among this latter may be mentioned catechu, gambier and elder, larch and willow barks.

It has been shown that a blue precipitate with persalt of iron given by a tannin shows it to be a glucoside, while the opposite occurs (with the exception of willow) with those which give a green one. All of these tannin matters are known for the avidity with which, in the presence of alkalis, they absorb oxygen and become in this manner converted into other bodies of different colors—green, red, brown, black.

Sumac, although identical with the other tannins, so far as the tannic acid is concerned, possesses a larger amount of gallic acid and also a yellow coloring substance.

It will be found that sumac, or rather its decoction, has a distinctly acid reaction and a yellowish green color, with a peculiar odor, and that it becomes turbid or muddy on cooling and gives the following reactions with the different salts:

Alkalies—White precipitate.
Gelatine—White precipitate.
Alum—Pale yellow precipitate.
Acids—Muddy precipitate.
Acetate of lead—Flocculent canary precipitate.
Lime, etc.—White passing to green precipitate.
Persulphate of iron—Blue precipitate.
Iodine—Pink precipitate.
Chlorine—Pink precipitate.
Tin—Yellowish white precipitate.

The tannins are most readily absorbed by vegetable fibers; they are capable of forming insoluble compounds with antimony and the heavy metals, and are therefore used larely as dyestuffs or bottoms in conjunction with the older vegetable dyestuffs. Basic coal-tar colors are also precipitated by the tannins (or tannic acid); they are therefore employed largely for these dyestuffs. Tannin is the purest form of tannic acid, and is readily soluble in hot water.

Sumac

Sumac contains gallo-tannic acid. It is sold as leaves or powder; the former quality is usually the purer. If sumac is used in place of tannin or tannic acid when mordanting, the goods themselves are tinted a brownish color by the mordant. It is better, therefore, to use the purer tannic acid mordant if the colors to be dyed are wanted brilliant or light in color. Four to five parts of sumac leaves are equal to one part of tannic acid, or two and one-quarter parts of sumac extract at 53 deg. Tw. should equal one part of tannic acid. Some of these extracts give very pure shades.

Sumac, being sold in a powdered state, is easily decomposed by the dampness of the air from gallo-tannic to gallic acid. Gallic acid reduces the ferric salts to the ferrous state, the color at the same time disappearing, so that it is of no use to the dyer who uses sumac and the persalts of iron together. The tannic, or rather the gallo-tannic, acid is consequently the only valuable constituent of sumac, and it is therefore of the first importance that the quantity of that matter in any sample of sumac should be known accurately.

Sumac is mostly used as a mordant, with some metallic salt, on flax or cotton fibers as a fixing agent for colors that could not otherwise be used, and this property that tannin possesses is often accentuated by running the goods through a bath of stannate or chloride of tin or iron, which prepares them for dyeing either with the vegetable dyestuffs or with the basic aniline dyes.

Nearly all the tables which show the action of metallic oxides on sumacit show that the protosulphate of iron gives a purplish tint and no precipitate, while the persulphate of iron gives a deep blue-black precipitate. It is not well to infer from this, however, that the persulphate of iron is the best for dyeing black, for this result is only temporary and is only true at the time the mixture is made; for in at least thirty minutes the blue black from the persulphate becomes a brownish slate, whereas the purple tint from the protosulphate changes to a deep black and this change continues until the latter becomes jet and permanently black.

It is quite customary to add a little oil of vitriol to a solution of sumac, as it not only retards fermentation but also assists in the production of both light and dark shades (not black) and makes the colors softer. The action of this acid on exposure to the air soon destroys the coloring matter which sumac contains, and therefore it is advisable to boil the sumac solution fresh each day.

Sumac, or its tannin derivatives, is used on a large variety of shades, such as slates, grays, drabs, blues, blacks and greens, which are very fast to all influences. And I might say here that it is useful and is much used as a bottom with tin for yellows, reds and purples of the natural dyewoods.

The following process of dyeing black will illustrate some of the reactions of sumac in connection with metallic bases: [The quotations in this article are from a book written by the author years ago.] "The goods are put to steep in a hot decoction of 25 pounds sumac extract or 15 pounds tannin and allowed to steep for twelve hours; i. e., they are put in hot and allowed to cool off. The goods are then passed through lime water, which gives them a beautiful bluish green color, becoming very dark with a short exposure to the air. If allowed to stand for half an hour the green color passes off and the goods assume a greenish dun shade. When they are at the darkest shade of green they are put through a solution of copperas; after cooking in this and exposing to the air they become black, but if dried from the copperas it is only slate or gray. They are now put through lime water, which renders them brown (and are better if washed); then they are worked in a weak solution of hot logwood and raised in a weak copperas liquor to a blue shade and clear the color. The goods are washed well from this in cold water and dried, if possible, in the shade. If the goods are too blue they may be altered to jet black by the addition of a little bark (quercitron) liquor to the logwood."

Sumac when cold, or nearly so, has a greater affinity for cotton cloth than it has while hot; it is therefore dissolved hot so that it will penetrate the fibers, and is then allowed to lie overnight, with the goods submerged, to cool off. It is also unnecessary to run the goods through the lime water previously to the ironing, but it is useful and had better be done, although the writer has dyed good blacks without it. It is also better to wash from the lime before entering the logwood, but not necessary. If the iron is in a state of protosalt, as copperas, the blackening is more permanent but slower. It must, however, be said here that the combination of tannin and iron which forms the black appears to depend on the iron oxide being rather lower than the peroxide and higher than the protoxide, and that the peroxide when used becomes reduced in oxidation and causes loss and change in reduction, and that the protoxide takes in oxygen as required; and, further, it has long been known that both tannic and gallic acids do not throw down the protosalts of iron if they are protected from open contact with the atmosphere. It has been seen, however, that when tannic or gallic acid is carried into a salt of the peroxide of iron it is always reduced to the state of a protosalt, and it is quite probable that the oxygen combining with the tannin converts it into an acid of a new color.

Gallein and cerulein and pyrogallol are also derivatives of sumac and will be treated later.

Catechu, Cutch, Gambier, Etc.

Catechu is another substance containing much tannin. Catechu, cutch and gambier are among the most valuable

matters that give a green coloration with persalts of iron. They may be used in all kinds of mixings to give a great number of shades, varying from light drabs to dark browns on cotton fibers. They have an astringent taste with a sweet after-flavor. They are soluble in acetic acid, in the alkalis and in alcohol, to which they give a reddish brown color. Their solution in water yields the following reactions:

Gelatine—Reddish white precipitate.
Alkalis—Give a decidedly reddish brown hue.
Lime water—Yellowish coloration and precipitate.
Protosalts of iron—Olive-green coloration.
Persalts of iron—Dark green coloration.
Salts of alumina—Clear the liquor, giving it a yellowish hue.
Sulphate of copper—Olive coloration.
Salts of lead—Yellowish gray precipitate.
Bichromate of potash (or soda)—Abundant brown precipitate.
Acetate of copper—Abundant blackish brown precipitate.

There are many kinds of catechu, but the Bengal is the variety mostly used and is the most useful to the writer, and so will be the kind referred to throughout this article, though all are alike and should be treated the same.

Catechu is much adulterated with blood, starch, mineral matters and tannin matters, but good catechu should not contain more than 4 or 5 per cent of ash. Yellow gambier is made into brown cutch by melting it and adding 1 per cent of bichromate of soda. This fraud is found out easily if the cutch is calcined and the ash tested for oxide of chromium. The value of catechu can be best tested if a sample is printed and the test compared with a test of known quantity. Schutzenberger advises that 4 ounces of vinegar thickened with gum be added to 2 ounces of catechu. This is printed on the fabric, steamed and passed through a weak solution of bichromate of soda. After washing and drying, the color is compared with the standard sample.

Good catechu is made up of three substances: First, as white crystalline matter, called catechuic acid or catechin; and, second, a matter that is wholly a tannin matter and is soluble in cold water, called catechutannic acid. The remainder is a brown body caused by the oxidation of the catchin during the evaporation of the plants.

We might say here that catechu and gambier resemble each other largely in their properties and are derived from similar East Indian plants. For our purposes they are the same thing and possess the same properties.

Referring again to the catechutannic acid, which occurs in all catechus, it will be found that it is readily soluble in water and alcohol, but insoluble in ether; that it gives a green precipitate with persalts of iron, and, like all tannins, that it gives precipitates with antimony and gelatine. It will also be found that this acid is slowly oxidized by exposure to the atmosphere, its aqueous solution becoming a reddish color. This change takes place more rapidly if alkalis be present. Catechuic acid or catechin, while quite soluble in hot or boiling water, is almost insoluble in cold water. While it is, in its solutions of water, quite neutral to litmus, it is readily soluble in alcohol and ether. Catechin rapidly becomes brown if subjected to an alkaline solution, but if acetic acid be added to it at this point it becomes yellower in color and gives a precipitate with gelatine. If this is now boiled, out of contact with the air, with dilute sulphuric acid it is decomposed into a brown powder, named catechureton; this by dry distillation yields pyrocatechin.

Svanberg says—and he ought to know—that in the presence of caustic alkalis a solution of catechin rapidly takes in oxygen and is converted into Japonic acid, which is thrown down as a black precipitate on the addition of hydrochloric acid. It is also converted into rubinic acid, protocatechuic acid, oxyphenic acid, etc., but they do not interest us at this time.

For dyeing cotton goods into fast colors, especially fustians, catechu is much used owing to the large variety of different drab shades it yields with different mordants. It is by this means that gray-drab or greenish shades are produced with aluminous mordants alone; light yellows or yellow drabs and chamois colors with chloride of tin, to which the red shades may be given with the red dyewoods. Various shades of brown may be produced with iron mordants, and these in turn may be fixed and brightened by the weak bichromate of soda or potash bath.

It is the dyers who avail themselves of the dyeing properties of catechutannic acid and catechin, while the calico printer who uses the catechu only for the production of browns requires only the catechin.

When dyeing any of the goods specified before, such as nets, sail cloths, hay caps, etc., the catechin is dissolved in boiling water, in which case it has a gummy consistency. It is not possible to dye cotton goods while in this state, therefore it is customary to add 5 per cent of some metallic salt, usually copper, which destroys the gummy principle. It is not well understood what, if any, chemical change takes place when the catechu solution receives the addition of the mineral salts; the explanation usually given is that the salt oxidizes the catechu, producing an insoluble oxide, which, however, is in turn soluble in a solution of catechu not oxidized. It is the belief of the author that the action is not a chemical reaction at all but a catalytic one, the metallic salt acting in the present case as a catalyst only.

A foreign body, if a catalyst, may make an insoluble body soluble by its mere presence, and that is what it does regarding the soluble catechu.

When dyeing cotton goods brown that require to be fast in color and mildew-proof, as the above, with chrome and catechu, it is best to make up the stock tubs as follows: Cutch or gambier, 450 pounds; water, 400 gallons. Boil well until thoroughly dissolved and add 90 pounds

sulphate of copper. Boil together until all is dissolved and allow to settle overnight.

Stock tub for bichromate of potash or soda: Bichromate of potash (or soda), 200 pounds; water, 400 gallons.

The process for dyeing a full brown for above is as follows: "The goods must be wet out in a solution of bottoms at a spring boil; run the goods through this once and allow to lie on rolls overnight. When catechu is dissolved in the stock tub and allowed to settle, a thick sludge of brown amorphous matter caused by the catechin during the evaporation of the decoctions, together with a large amount of unoxidized catechin, which will crystallize out of the solution as it cools, will settle to the bottom of the stock tub. This, with the overflow of catechu liquor from the dyeing machine, is run into a separate tank or stock vat and, after being well boiled up, is made up to 400 gallons with water and constitutes the liquor known as bottoms. This bottoms liquor is run into a dyeing machine and the goods are run through it at a spring boil at a speed of 50 yards per minute. Run the goods into large rolls containing from 1,000 to 3,000 yards, according to weight.

"The goods are then run again the next morning through the boiling bottoms and taken to a similar machine made up as a permanent bath with cutch of the full strength of the stock tub; the goods are run once through this and the strength kept about 8 deg. Tw. by feeding 8 quarts of stock liquor on every 100 yards while the goods are running. It is not advisable to use steam or heat at any stage of the process. The overflow should be caught for future wettings-out. Run once in cool cutch, let lie overnight and run again; then chrome on a similar machine, giving the runs boiling hot. Start the bath with four pails of bichrome and eleven pails of water, feeding with one pail of bichrome on each 100 yards of cloth. Give each roll two ends in the chrome and then get fresh liquor for each roll of goods. Wash and mangle at once, not leaving overlong. A deep reddish brown is produced by this process, suitable for above colors; but if a yellow or any darker shade is wanted the goods must be run, either before or after the chrome, in nitrate of iron or copperas. If after-chromed, the goods must be washed well before ironing."

If this method of dyeing be followed the goods are dyed through; the cutch is cold and they stand overnight in it, therefore it soaks right through and penetrates to the center and all the fibers are oxidized into Japonic acid. In this way they are dyed completely through, are very permanent and will not mildew. A great number of shades are got by adding other dyewoods to the bath or by topping catechu with these shades.

It is also much used in dyeing blacks in conjunction with logwood.

For a dark brown on cotton yarn (50 pounds) work one hour at 170 deg. Fahr. in a bath containing 14 pounds catechu, 4 pounds logwood extract (solid), 2 pounds quercitron extract (solid). Allow to drain one-quarter of an hour at 170 deg. Fahr.; raise in a batch with 2 pounds chrome; wash and dry.

For a dark maroon on cotton yarn (50 pounds) use 12 pounds catechu, 1 pound copper sulphate, 4 pounds logwood extract (solid). Enter yarn at 190 deg. Fahr., give a few turns and steep overnight. Take up in the morning at 190 deg. Fahr. and work with 3 pounds chrome. Return to first bath, to which 4 pounds logwood extract have been added; work for half an hour, wring and pass through an emulsion of soap and oil; wring and dry.

Work for fifteen minutes in warm water to which has been added 4 pints catechu (41 deg. Tw.); lift and add 2 ounces copperas in solution and work another fifteen minutes. Wash from this in one tub of water and finish through warm water in which as much soap has been dissolved as will raise a lather.

A great variety of drabs can be dyed by varying the proportions of these matters. No. 41 is made by adding to 7 or 8 gallons of water 1 pound catechu and boiling until all is dissolved; then add 2 ounces nitrate or sulphate of copper and stir, when it is ready for use. Any quantity can be used in the same proportions. Water is from 7 to 10 gallons; copperas is ½ pound to the gallon, with a little sulphuric acid added.

POTASH—TWIN TO CAUSTIC SODA

(*Continued from page* 585)

than sodium compounds, weight for weight they do not increase the activity of the soap solution to the same extent as sodium compounds. The reason is that the weight of a molecule of caustic potash (KOH) is 1.4 times as much as a molecule of caustic soda (NaOH). This means that 1.4 ounces of potash are required to do the same work as 1 ounce of caustic soda. Almost half as much again of the potassium compounds are necessary as of the sodium compounds.

Caustic soda (NaOH) is a combination of sodium with oxygen and hydrogen. The latter two are usually grouped together by the chemist into what he calls the OH ion or hydroxyl ion. The combination of potassium with oxygen and hydrogen is called caustic potash (KOH). When you dissolve caustic potash in water, the same separation takes place as in caustic soda and the OH ion splits off from the alkali base, forming what the chemist describes as active alkali or available alkali. One pound of caustic soda gives you the same amount of this active alkali as you would get from 1.4 pounds of caustic potash.

Another sodium compound, known as soda ash (Na_2CO_3), has its equivalent in the potash family as pearl ash (K_2O_3).

The Commonwealth Color & Chemical Company announces the appointment of Charles E. Foster as sales manager for its New England territory. Mr. Foster has been in the dyestuff industry, as dyer and sales manager, for twenty-two years.

Dyestuff Tables

A List of the Principal American-Made Colors with Their Properties and Fastness Characteristics

[NOTE: The publishers of The REPORTER have secured more or less complete data in regard to many of the dyestuffs which are at the present time being manufactured in the United States. As the following material has been brought together from various sources, they realize that errors are quite likely to appear, and it is earnestly requested that any readers who find errors or who are able to give additional information will communicate with the publishers in order that this material may be made as correct, complete and up to date as possible. These tables will appear serially until all colors upon which we have data shall have been covered. The publication of this data was begun in the issue of March 10, 1924.]

The following letter indicates that some of our readers are sufficiently interested in the accurate publication of these tables to call to our attention errors that are bound to occur from time to time. While this particular communication treats of a minor correction, yet we trust that it will be followed by similar criticisms from others of our readers who may discover inconsistencies in the data published under the above title. In fact, the main purpose in publishing these Dyestuff Tables is to present them for criticism, as it is obvious that in material of this nature many technical errors may occur. The publishers do not presume to offer them as being accurate in every respect and for that reason are grateful when those who are better informed indicate the inaccuracies.

"Gentlemen: In the Dyestuff Tables which appeared in the issue of March 24th there was a description of Chrysodine Y (Schultz No. 33). Under the heading 'Other Materials,' it stated: 'Is a good substitute for cutch. Dyes deepest on bleached pulp.' I believe an error has been made here, and that it should have read 'unbleached pulp.' Practically none of the basic colors are used on bleached pulps, owing to their poor affinity; again, bleached stocks are generally used on bond, ledger and writing papers, wherein fastness to light is very essential.

"This criticism is made in a constructive spirit, as I feel quite certain that it was an unintentional error.

"JOHN CASTLE, Bound Brook, N. J."

ALKALIE BROWN
(Schultz No. 190)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Cotton.

USUAL METHOD OF DYEING: With salt or salt and soda.

SHADE: Reddish brown.

SOLUBILITY: Good.

LEVEL: Fair.

EXHAUSTS: Well.

FASTNESS TO:
- **Acid:** Fast.
- **Alkali:** Fast.
- **Carbonizing:** Not suitable.
- **Chlorine:** Not fast.
- **Fulling:** Not fast.
- **Ironing:** Shade changes.
- **Light:** Moderate fastness.
- **Rubbing:** Fast.
- **Scouring:** Not fast.
- **Washing:** Very moderate.

DYED BY OTHER PRODUCTS: When after-treated with formaldehyde the color is faster to washing.

ON OTHER MATERIALS: No interest.

PRINTING: Not suitable for discharge printing.

COMPETING PRODUCTS: Made in the United States by Peerless Color Corporation (Selling Agents, Dunker & Perkins Company).

STANLEY RED
(Schultz No. 193)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Cotton, wool or silk.

USUAL METHOD OF DYEING: Cotton, dyed direct with salt; wool and silk, with Glauber salt and acetic acid.

SHADE: On cotton, pink; on wool and silk, scarlet red.

SOLUBILITY: Good.

LEVEL: Not very level on wool and silk.

EXHAUSTS: Well.

FASTNESS TO (ON WOOL AND SILK):
- **Fulling:** Moderate, dyed acid; faster when top-chromed.
- **Ironing:** Turns yellow.
- **Light:** Moderate, dyed acid; faster, top-chromed.
- **Perspiration:** Moderate.
- **Potting:** Not fast; color bleeds.
- **Scouring:** Moderate, dyed acid; faster, top-chromed.
- **Steaming:** Moderate.
- **Sulphur:** Moderate.

OTHER PROPERTIES: Top-chromed, the shade is duller.

ON UNIONS: In a neutral bath on cotton-wool unions the cotton is heavier than the wool.

PRINTING: Not adapted for discharge work.

COMPETING PRODUCTS: Made in the United States by Peerless Color Corporation (Selling Agents, Dunker & Perkins Company).

THIAZINE RED R
(Schultz No. 194)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Cotton and wool.

USUAL METHOD OF DYEING: On cotton, with salt; on wool, with Glauber salt and acetic acid.

SHADE: Pink in light percentage; in heavy percentage, a bluish red.

SOLUBILITY: Very good.

FASTNESS TO (ON COTTON):
Acid: Fast to organic acids; not fast to sulphuric acid.
Alkali: Not fast to alkalies; the shade changes.
Chlorine: Not fast.
Cross-Dyeing: Not fast.
Ironing: Turns yellow.
Light: Moderate.
Rubbing: Fast.
Scouring: Moderate.
Sulphur: Fast.
Washing: Moderate.

FASTNESS TO (ON WOOL):
Acid: Fast to organic acids; not fast to sulphuric acid.
Alkali: Not fast to alkalies; the shade changes.
Carbonizing: Not fast.
Cross-Dyeing: Not fast.
Fulling: Fast.
Ironing: Fast if after-treated.
Light: Better than on cotton.
Perspiration: Fast.
Potting: Not fast.
Rubbing: Rubs off.
Scouring: Moderate, dyed direct.
Steaming: Moderate, dyed direct.
Sulphur: Fast.

SENSITIVE TO METALS, LIME: Not sensitive to chrome.

DYED BY OTHER METHODS: Top chrome on wool, the shade is lighter. After-treated with copper sulphate on wool, the fastness to washing and light is better; the shade is duller and weaker.

ON UNIONS: On cotton-silk unions the color goes on the silk. On cotton-wool unions dyed in a neutral bath the color goes mostly on the cotton; the wool is stained yellowish.

ON OTHER MATERIALS: Silk: Dyed in a broken boiled-off liquor, the shade is fairly fast to water. Paper: Good, especially for blotting paper and other unsized pulp. Addition of copper sulphate improves the light fastness for wall paper.

PRINTING: Adapted for cotton printing in light shades of pink. Can be printed on wool with acetic acid.

DISCHARGING: Discharges yellow with tin crystals and zinc dust on cotton and wool.

COMPETING PRODUCTS: Made in the United States by Cincinnati Chemical Works (Selling Agents, Geigy); Essex Aniline Works (Selling Agents, Grasselli Dyestuff Corporation); Newport Chemical Works.

ROSOPHENINE SG
(Schultz No. 195)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Cotton, wool and silk.

USUAL METHOD OF DYEING: On cotton, with salt; on wool, with Glauber salt and acetic or sulphuric acid; on silk, with boiled-off liquor broken with acetic acid.

SHADE: In light percentage, pink; in heavy percentage, crimson.

SHADE BY GASLIGHT: Yellower.

SOLUBILITY: Excellent.

LEVEL: Dyes level on cotton and silk; care must be used in dyeing wool.

EXHAUSTS: Not clear on cotton.

FASTNESS TO:
Acid: Fast.
Alkali: Fairly fast.
Carbonizing: Fast.
Light: Moderate fastness on all fibers.
Potting: Fairly fast on cotton and wool.
Rubbing: Fast on cotton and wool.
Scouring: Fairly fast on cotton and wool.
Washing: Good fastness.
Water: Good fastness on cotton and wool.

SENSITIVE TO METALS, LIME: Copper changes the shade to a brownish red.

DYED BY OTHER METHODS: Top-chromed, the shade is somewhat lighter on wool.

ON UNIONS: Cotton-wool unions dyed by the two-bath process: cotton heaviest. Cotton-wool union in a neutral bath: the wool is only slightly stained. Cotton-silk unions: the silk is heavier than the cotton.

ON OTHER MATERIALS: Silk: dyed in a bath of boiled-off liquor broken with acetic or in a neutral bath with Glauber salt, the color is quite fast to water and to soap on this fiber.

PRINTING: Adapted for printing on cotton; adapted for printing on wool direct with acetic acid.

COMPETING PRODUCTS: Made in the United States by Essex Aniline Works (Selling Agents, Grasselli Dyestuff Corporation); Peerless Color Corporation (Selling Agents, Dunker & Perkins Company); Noil Chemical & Color Works.

THIAZINE RED G
(Schultz No. 197)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Cotton, wool and silk.

USUAL METHOD OF DYEING: On cotton, with salt; on wool, with Glauber salt and acetic acid; on silk, with boiled-off liquor and acetic acid.

(Continued on page 608)

CHEMISTRY APPLIED TO HAWICK'S STAPLE INDUSTRIES

Stanley L. Burrows, F.C.S., director of the Central Laboratory, Buccleuch Memorial Technical Institute, Hawick, Scotland, writing in the British Industries Review, describes how the Scottish textile manufacturers are reorganizing their business on scientific principles. With one or two exceptions, he writes, Scottish industrial laboratories connected with the woolen textile trade were, until recently, quite unknown. Under the vast stimulus of war, however, many national laboratories were established, which went far to remedy the pre-war apathetic attitude toward industrial chemistry. It was toward the close of 1919 that the Scottish Woollen Trades Employers' Association (Hawick branch) and the Hawick Hosiery Manufacturers' Association decided to establish their own industrial laboratory in the Buccleuch Memorial Technical Institute, Hawick, and to appoint Stanley L. Burrows, F.C.S. (formerly with Woolcombers, Ltd., Bradford), as chief works chemist. On the completion of the erection and furnishing of the laboratory it was formally opened on October 18, 1920, by Major H. W. Bliss, Director of Research Association for the woolen and worsted industries. The equipment of the laboratory is of the most up-to-date type, and represents the very last word in scientific control for the textile industries. The work undertaken in the laboratory includes both analytical and experimental investigations.

The experimental work carried out has been directed solely with a view to effecting a general improvement of the manufacturing processes and eliminating waste. In this manner the various works-processes, such as scouring, bleaching, dyeing, unshrinkable processing and finishing, etc., have first been studiously examined in the works, and then subjected to scientific investigation in the laboratory, where by further research and experimental work, the best methods have been worked out in full detail. The new and improved processes have then been introduced and installed in the factories, and the existing plant and machinery has been remodeled and brought fully up to date. In this connection analytical control tests for the various works-processes have been devised in the laboratory and then installed in the factories, whereby the practical man or foreman has been enabled to establish standard uniformity in the quality of output, thus maintaining the world-wide reputation of the finished product. In this way the chemist, with the cordial co-operation of the managers, foremen, and workmen in the factories, has greatly reduced production costs, and has improved sumultaneously the quality of the product as delivered to the customer.

The most important function of this department has been the supervision of the works processes by routine inspection, which has insured regularity and quality of product and also maintained the works in the highest state of efficiency. The utilitarian value of the work carried out by the department has demonstrated convincingly that the successful application of scientific research to industry is the only possible basis on which progressive industries can be built up.

Supplementary to the work connected with the manufacturers' associations is the educational work carried out in the continuation classes, which is run in close co-operation with the County of Roxburgh Education Authority, the object being to improve the technical education of apprentices engaged in the scouring, bleaching, dyeing, and finishing connected with the Scotch tweed and hosiery industries. Here, provision is made for carrying out experiments on the laboratory scale in the application of all classes of dyestuffs to wool, silk, cotton, and the various kinds of artificial silks, etc., and the testing of the relative fastness of these colors to meet the requirements of the local trades.

Arrangements are also made for carrying out practical experimental work, demonstrating the effect of the various acids, unshrinkable processing chemicals, de-chlorinating agents and bleaching materials on hosiery, together with the testing of the relative fastness of the bleached unshrinkable-processed product to shrinkage and milling, etc. The current technical literature and all patents relating to machinery and processes applicable to local conditions are consistently scrutinized and examined. The subjects are thus treated both from the scientific and industrial aspect, and it has proved itself to be of the utmost service to the local tweed and hosiery industries.

THE NEXT CHEMICAL SHOW

Owing to some confusion which is believed to exist in a few quarters regarding the holding of the next chemical exposition, an announcement has been sent out by the International Exposition Company, under whose management the Exposition of Chemical Industries has been held since 1915. Numerous inquiries have been received by the management which lead it to believe that many interested parties are of the opinion that there will be a chemical exposition this year. This is not the case. There will be no chemical exposition in 1924; the next Exposition of Chemical Industries will be held September 28 to October 3, 1925, at the Grand Central Palace, New York.

On August 26, 1924, U. S. Letters Patent No. 1,506,316 were granted to the Pharma-Chemical Corporation as the assignee of Eugene A. Markush, inventor, for improvements in Pyrazolone dyes and processes of making the same.

Chas. O. Lavett, for many years associated with the Buffalo Foundry & Machine Company, as engineer in charge of Tests and Field Erection, is now associated with the Chemical & Vacuum Machinery Company, Inc., as manager of that company.

Technical Notes from Foreign Sources

Pattern Effects on Fabrics

British Patent No. 215,860 describes an interesting process in the production of pattern effects on fabrics that contain artificial silk by means of a process of mercerization. These pattern effects are secured by subjecting the fabrics that contain artificial silk fibers to the action, in selected areas only, of mercerized agents other than caustic soda. Such agents as sulphuric acid, hydrochloric acid, phosphoric acid or nitric acid are used, as well as zinc chloride, cuprammonium or calcium thiocyanate solution.

The mercerizing agent may be directly printed on the fabric or the fabric may be first printed with a resist—either starch or British gum, and then immersed in the mercerizing agent. When the fabric contains cellulose acetate silk and the latter method is employed, the limits of treatment are: From one to fifteen seconds with sulphuric acid of 80 to 168 deg. Tw. (density 1.14 to 1.84) at a temperature of 13 deg. Cent. to two hours with phosphoric acid of 129 to 160 deg. Tw. (density of 1.65 to 1.80) at a temperature from 12 to 93 deg. Cent.; from one to fifteen seconds with hydrochloric acid of 26 to 40 deg. Tw. (density of 1.13 to 1.20) at a temperature of 13 deg. Cent.; from one to five seconds with nitric acid of 60 to 82 deg. Tw. (density of 1.30 to 1.42) at 13 deg. Cent.; from zero to fifteen minutes with cuprammonium solutions containing 2.5 to 5.0 per cent of copper at 13 to 82 deg. Cent., and from two seconds to one hour with calcium thiocyanate solutions containing 25 to 90 grams per 100 c.c. of solution at 13 deg. Cent.

Dyeing Properties of Cotton, Flax and Hemp

An investigation was made to determine the differences that exist between the dyeing properties of cotton, flax and hemp. The results of this investigation were reported in the German journal Cellulosechem., 1924, pages 33-44.

The tests were made by taking samples of pure bleached cotton and of cottonized flax and hemp, and dyeing them under comparative conditions in cold and hot solutions of direct cotton dyes in water. Various amounts of different assistants were added to the dye baths. The effect of the addition of these materials was noted.

It was found that the addition of sodium carbonate has no effect in retarding the dyeing process if the concentration of the salt does not exceed 4 grams per liter. Crystalline sodium sulphate is employed to aid in exhausting the dye bath. It was found that 100 parts of this salt can be replaced by 58 to 60 per cent of sodium chloride and 25 to 41 per cent of any hydrous sodium carbonate, the first figures referring to the proportion of the salt in the cold bath and the second to the proportion in the hot bath. Equally good results were obtained in this manner as when Glauber salt was employed.

In examining the depths of color obtained on the fibers it was found that the depth of color was at a maximum on the cotton, less on the flax and least on the hemp. Thus, a test was carried out on all three fibers by immersing them in a 1 per cent solution of potassium bichromate in 75 per cent alcohol for a period of one hour at a temperature of 15 to 20 deg. Cent. All three fibers were found to be dyed to the same depth of shade. Since the swelling of cotton, flax and hemp fibers in 75 per cent alcohol and in water was 2.3 and 16 per cent, 11.5 and 17.1 per cent, and 14.9 and 16.7 per cent, respectively, it is concluded that the differences in the dyeing properties of these fibers is due to the differences in the nature of their cuticles and that the permeability of the outer cellulose membranes of these fibers to coarsely dispersed dyestuffs also decreases in the order named.

Artificial Wool from Cotton

The process patented in German Patent No. 393,803 is concerned with an improvement in the method of manufacturing an artificial wool product from cellulose by treatment with acetic acid anhydride in the presence of catalysts. It is intended to avoid the great consumption of acetic anhydride that takes place under ordinary conditions, which renders the process rather costly to carry out.

It was found that a variety of artificial wool can be manufactured from cotton or other cellulosic fibers when they are treated with a mixture of acetic acid anhydride and sulphur trioxide at a temperature below 80 deg. Cent. This treatment serves to acetylate the surface of the fiber to a greater or lesser depth, dependent on the time that the chemicals are allowed to act on it. At the close of the acetylation process steam is conducted through the fibers at a temperature which is as low as possible, and under certain conditions a little ammonia is added to it. The treatment with steam lasts until no more acid can be removed from the fibers. Under certain conditions a mixture of acetic acid anhydride, hydrochloric acid gas and sulphur dioxide is employed. When pure cellulose is treated, a mixture of acetic acid anhydride and sulphur dioxide or of acetic acid anhydride and dry hydrochloric acid gas is employed for a period of half an hour to one hour.

THE DYEING OF ACETATE-CELLULOSE SILK

(*Continued from page 596*)

printed by this process. In a similar manner sulphur colors can be printed, using an addition of caustic soda and glucose to the printing paste. Fast shades can also be obtained with vat dyestuffs, and in this case a larger amount of caustic soda is necessary than when printing the same dyestuffs on cotton. After printing with vat colors and drying, the goods are aged for five minutes at 100 to 101 deg. Cent. with moist steam, washed and soaped at 80 deg. Cent. Soap boiling, of course, must be omitted, and colors which are not otherwise fully oxidized can be completely developed by an aftertreatment with bleaching powder solution.

Discharge printing is a difficult problem and the majority of colors dyed on acetate-silk are difficult to discharge, but the dischargeable direct colors dyed on saponified silk give fairly good whites with 10 per cent. formosul.

In conclusion I wish to express my thanks to the British Dyestuffs Corporation Ltd., in whose laboratories the work connected with this paper has been carried out.

STANDARDIZATION OF BIOLOGICAL STAINS

The following is an abstract of an article by Major R. E. Scott, Medical Corps, U. S. Army, and R. W. French, Laboratory, Walter Reed General Hospital, published in the Military Surgean, August, 1924:

"The certainty of biological staining reactions has of recent years been much reduced owing to utter lack of uniformity of dyes as regards chemical composition, concentration and performance. The variations found in samples of Methylene Blue, in polychrome stains and in gentian violets for green stains are described. The importance of H-ion concentration and the use of proper buffer solutions are emphasized. The system of uniform nomenclature proposed by the Commission on Standardardization of Biological Stains is advocated and tabulated. More than eighty different dyes used as biological stains are listed."

"One Operator Dyes 5,000 Pounds per Day" is the title of an interesting folder distributed by the Franklin Process Company. It is neatly illustrated with photographs and drawings, and outlines the advantages and main features of the manufacturers' rawstock machines from the viewpoint of labor cost and volume production.

The Department of Commerce has issued detailed figures showing the exports of dyestuffs from the United States during July. Totals on the principal items follow: Logwood extract, 193,269 pounds valued at $27,448; other dye extracts, 151,340 pounds valued at $20,307, principally to Scotland; coal tar colors, dyes and stains, 1,818,873 pounds, valued at $555,615, of which more than two-thirds went to China.

RECENT PATENTS

Mixing Liquids

(1,496,858; June 10)

Rudolf Knollenberg, Lubeck, Germany.

The method of mixing and homogenizing liquids, consisting in causing oppositely directed jets of these liquids to strike each other repeatedly under pressure.

Liquid mixing and homogenizing device comprising in combination, a body, a plurality of borings extending through said body in longitudinal direction and substantially radical channels interconnecting adjoining pairs of such longitudinal channels.

Process for Dyeing Acetyl Cellulose

(1,498,315; July 8)

James Bradley and James Hill, Manchester, and Edward Bertram Anderson, Hemyock, near Tiverton, England, assignors to British Dyestuffs Corporation Limited, Manchester, England.

The process of dyeing acetyl cellulose which consists in applying amino-azo dyestuffs containing a diazotizable amino group, said dyestuffs being solubilized by the presence of carboxy groups and containing no sulphonic acid groups, to the material from the usual water dye bath.

Process of Bleaching Fibrous Material

(1,500,378; July 8)

Viggo Drewsen, Brooklyn, N. Y., assignor to West Virginia Pulp & Paper Company, New York, N. Y.

The process of bleaching wood fiber cellulose material that has been produced by the digestion of raw vegetable fiber with soluble monosulphite solution, which comprises treating the washed fiber while suspended in water with chlorine and simultaneously agitating the same, washing out the chlorination product thus formed and further bleaching the fiber with bleaching powder as an after-bleach.

Spot-Dyeing Process for Textile Fibers

(1,498,079; July 8)

Herman Epstein, New York, N. Y.

The process of spot dyeing a mass of textile fibers consisting in: first, spreading the fibers thin and flat; second, covering lengths of the fibers in a dyeing liquor; fourth, moving the covered portions of the fibers to and from each other in the liquor to spread the exposed lengths of fibers; and fifth, drying the fibers.

Waterproofing for Cloth

(1,502,598; July 22)

Nathaniel A. Thompson, Kansas City, Kans.

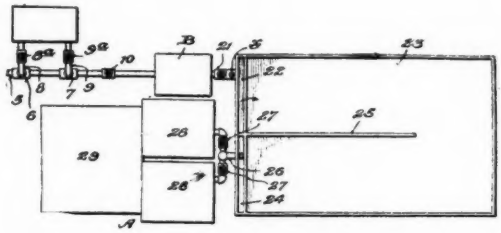
A waterproofing composition composed of a viscid vegetable oil, approximately 40 to 50 per cent, rubber 5 to 10 per cent, asphalt 5 to 10 per cent, and a filler of 30 to 50 per cent.

Process for Softening Water

(1,502,188; July 22)

Frank E. Hartman and Harry Buxton Hartman, Scottdale, Pa., assignors to Electric Water Sterilizer & Ozone Company, Scottdale, Pa.

A process for aiding the chemical softening of water, which consists in injecting a softening reagent under



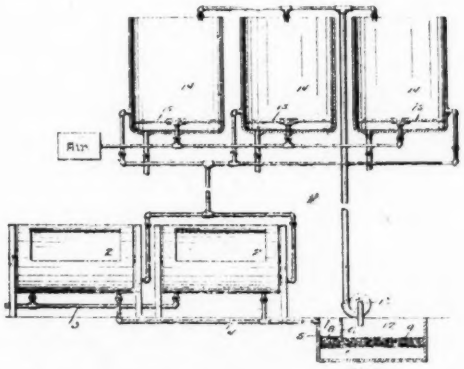
pressure into the feed line, next predisposing the water under pressure to rapid reaction by electrolysis, and subsequently conducting the chemically and electrically treated water through a relatively capacious sedimentation basin.

Process of Recovering Laundry Material

(1,502,270; July 22)

Frank L. Rosenau, San Francisco, Calif.

The process of recovering soap, water-softening material and water for reuse in washing operations, which comprises flowing the second suds and subsequent



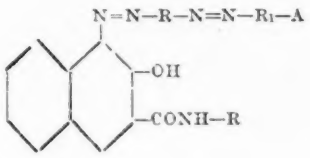
rinses used in washing into a settling tank, treating the mixture to increase the specific gravity of the impurities, whereby the impurities are caused to settle and withdrawing the supernatant liquid for reuse.

New Azo Dyestuffs

(1,503,044; July 29)

Joseph Haller, Wiesdorf, near Cologne-on-the-Rhine, Germany, assignor to Farbenfabriken vorm. Friedr. Bayer & Co., Leverkusen, near Cologne, Germany.

As new articles of manufacture the dyestuffs having most probably the formula:



wherein A means an alkylamino group, R_1 an aromatic residue containing a negative group, R an aromatic residue, which dyestuffs when reduced give an alkylized diamine containing a negative group which may be changed by reduction, a diamine and an arylid of 1-amino-2-oxynaphthoic acid, substantially as described.

The National Association of Finishers of Cotton Fabrics, 320 Broadway, New York City, have issued a revised index to all the color names and color numbers which have been issued by the Textile Color Card Association of the United States including the 1924 Fall Card. It is a convenient and useful reference and is cross indexed for color names and color numbers. Copies may be had free on application to the National Association of Finishers of Cotton Fabrics, 320 Broadway, New York City.

The Chemical & Vacuum Machinery Company, Inc., Buffalo, N. Y., has been incorporated to acquire the patents and all developments of the research plant established by E. G. Rippel and his associate, Chas. O. Lavett. The directors elected are J. F. Schoellkopf, Jr., William Schoellkopf, John Casa Eguia, Chas. O. Lavett and E. G. Rippel. The officers elected are E. G. Rippel, president; John Casa Eguia, vice-president; William Schoellkopf, secretary-treasurer, and Chas. O. Lavett, manager. The company will market a modern and improved line of apparatus for the manufacture of chemicals, electro-chemical products, dyes, pharmaceuticals, food and food by-products recovery apparatus, explosives, acids, extracts, etc.

E. G. Rippel, for many years associated with the Buffalo Foundry & Machine Company, having organized that company originally in 1901, has recently become connected with the Chemical & Vacuum Machinery Company, Inc., Buffalo, N. Y., as president of that company.

DYESTUFF TABLES

(*Continued from page 603*)

SHADE: In light percentage, a yellower shade of pink than S-194.

SOLUBILITY: Very good.

LEVEL: Dyes level on cotton; on wool care must be used.

EXHAUSTS: Not clear on cotton.

FASTNESS TO (ON COTTON):
Acid: Fast to organic acids.
Alkali: Fast.
Carbonizing: Not suitable.
Chlorine: Not fast.
Ironing: Turns yellower.
Light: Moderate.
Rubbing: Fast.
Sulphur: Shade goes bluer.
Washing: Moderate.

FASTNESS TO (ON WOOL):
Acid: Fast after-treated with copper.
Alkali: Fast.
Carbonizing: Not suitable.
Ironing: Fast after-treated with copper.
Light: After-treated, very fast.
Perspiration: Fast.
Rubbing: Rubs a little.
Scouring: After-treated, very good.
Sulphur: Lighter and yellower.
Washing: Fast after-treated.

DYED BY OTHER METHODS: Dyed on wool and top-chromed, the shade is lighter. Dyed on wool and after-treated with copper sulphate, about 5 per cent, the shade is duller and faster to washing, fulling and light.

ON UNIONS: Cotton-silk unions: The silk is dyed heaviest. On cotton-wool unions dyed in a neutral bath the wool is lighter than the cotton.

ON OTHER MATERIALS: Silk: Dyed in a bath of boiled-off liquor broken with acetic acid, the color is fairly fast to water on this fiber. Paper: O. K., especially for blotting paper. Jute: Dyed with common salt at the boil.

PRINTING: Adapted for printing on cotton in light pink shades. Prints on wool with acetic acid.

DISCHARGING: Discharges yellow to brown on cotton with tin and zinc dust. Discharges yellow on wool with tin or zinc dust.

COMPETING PRODUCTS: Made in the United States by Grasselli Dyestuff Corporation; Peerless Color Corporation (Selling Agents, Dunker & Perkins Company); Garfield Aniline Works.

MIMOSA C

(Schultz No. 198)

COMPOSITION: Mono azo.

SPECIALLY SUITABLE FOR: Cotton.

USUAL METHOD OF DYEING: With common salt and soda.

SHADE: Reddish yellow.

SOLUBILITY: Very good.

LEVEL: Dyes level.
EXHAUSTS: Well.

FASTNESS TO:
Acid: Redder.
Alkali: Redder.
Chlorine: Color destroyed.
Fulling: Better than S-194, S-195, S-197.
Ironing: Fast.
Light: Fugitive.
Perspiration: Moderate.
Rubbing: Fast.
Washing: Better than S-194, S-195, S-197.

MACHINE DYEING: Suitable for pad dyeing.

OTHER PROPERTIES: Used in making test paper for testing free alkali. The color is too fugitive to light to have much value on textiles.

DYED BY OTHER METHODS: Adapted for the dyeing of mercerized cotton.

ON UNIONS: Suitable for cotton-wool unions and also cotton-silk unions and gloria.

PRINTING: Adapted for printing on silk, though not fast to water. Adapted for printing on wool with acid.

DISCHARGING: Cannot be discharged with either tin crystals or zinc dust.

COMPETING PRODUCTS: Made in the United States by Essex Aniline Works; Newport Chemical Works; Peerless Color Company, Inc.; Grasselli Dyestuff Corporation.

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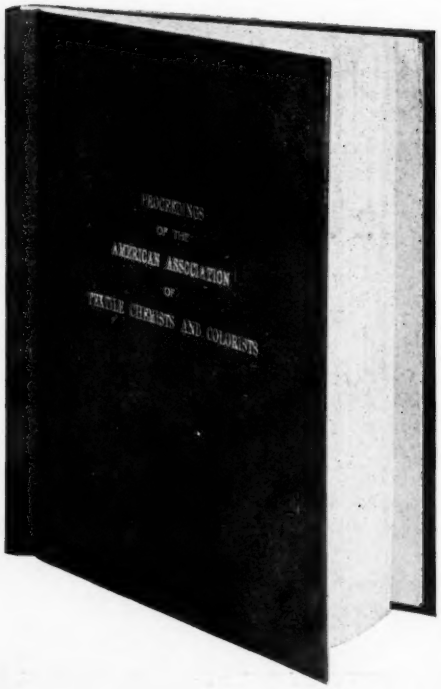

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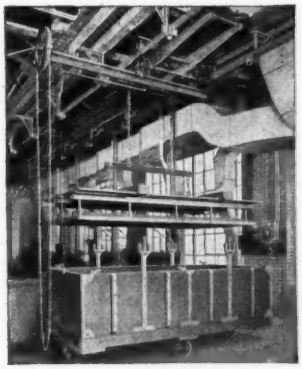

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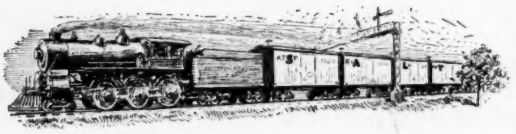

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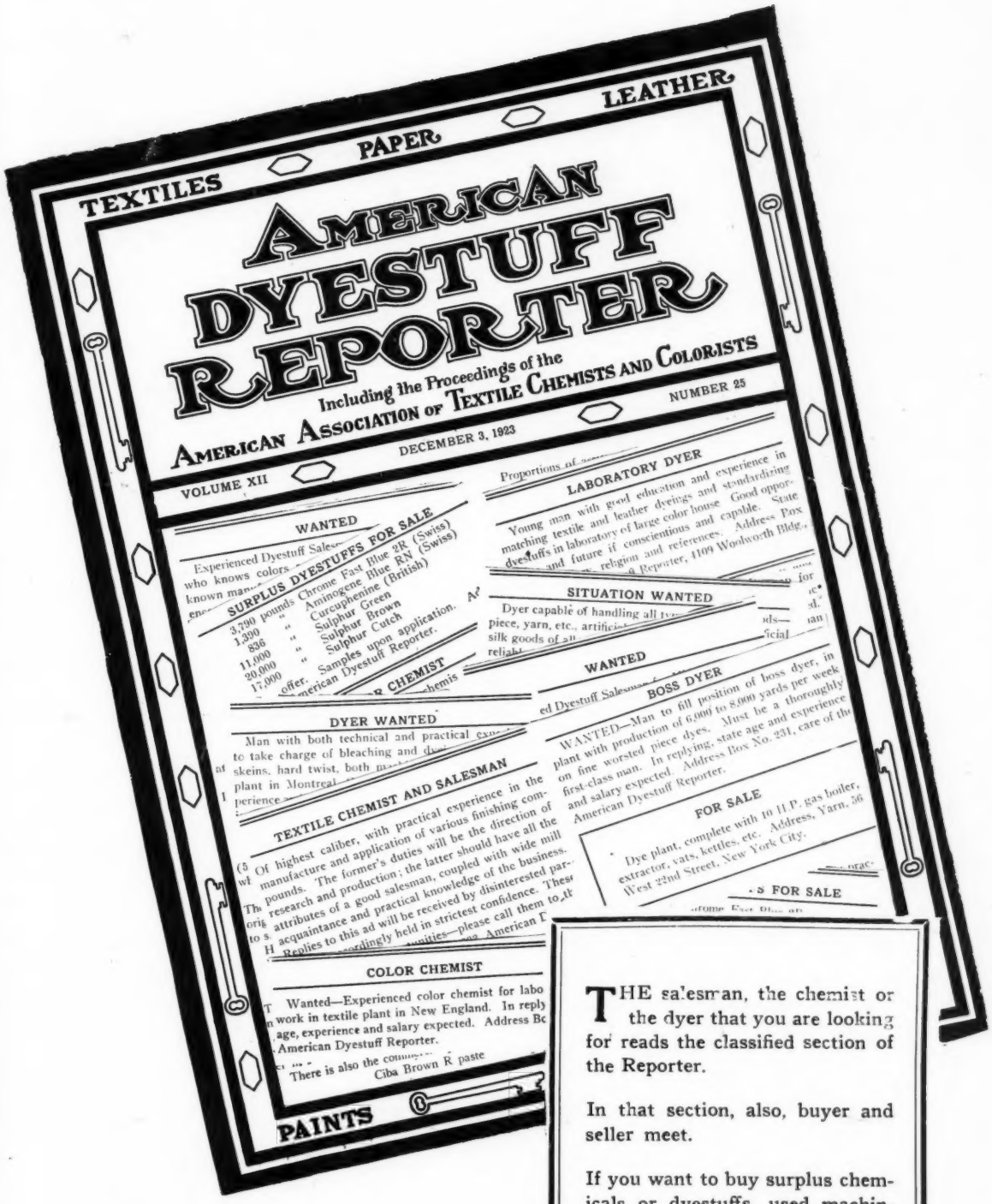

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